

POPULAR SCIENCE

April 1948 • 25c



*10 Easy Ways to
Get "that Extra Room"*

PAGE 98



THE HOME MECHANIC'S HANDBOOK

**PAINTING
DECORATING
WOODWORKING
METALWORKING
PLUMBING
MASONRY
ELECTRICAL WORK**

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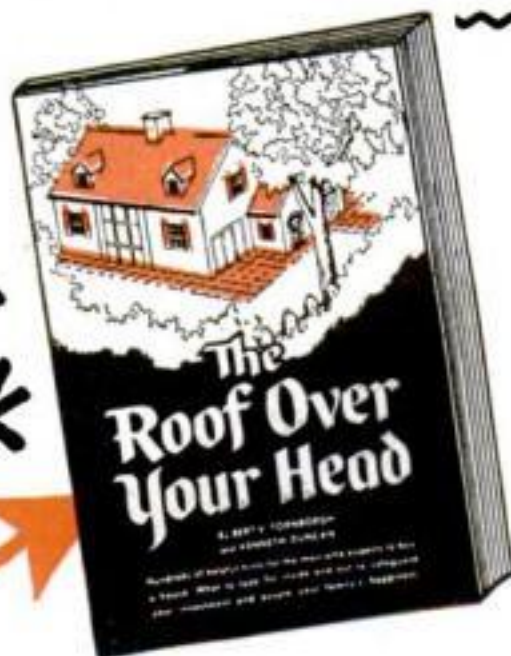
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Principles of paint mixing, formulas, and how to obtain any desired hue. Full directions for selection and care of brushes and other equipment. How to calculate amount of paint required, and best methods of applying to wood, metal, brick, concrete, stone, stucco, plaster. Exterior house painting—interior house painting—choice of color schemes. Complete directions, fully illustrated, for obtaining decorative effects—stippling, mottling, texturing, stenciling, striping, etc. Methods of finishing with stain, shellac, varnish, and wax. Proper stains for each variety of wood. Detailed step-by-step instructions for wall-papering. How to finish an auto, quickly, easily, and inexpensively.

WOODWORKING

The many varieties of wood and their relative merits, working qualities, and uses. Plywoods, veneers, and wood substitutes—how to choose the materials best suited for the job. Sizes, types and functions of all carpentry tools—how to use, sharpen, and adjust them. All the basic operations and processes of woodworking—everything from how to avoid warping to full directions for cutting each of the common joints. Wood turning—the different cuts, roughing, facing, sanding and finishing; drilling, boring, morticing, spinning, polishing. Hundreds of repair jobs and new constructions—inside and outside the house—are fully explained with diagrams and every practical fact you need to get the best results.

METAL WORKING

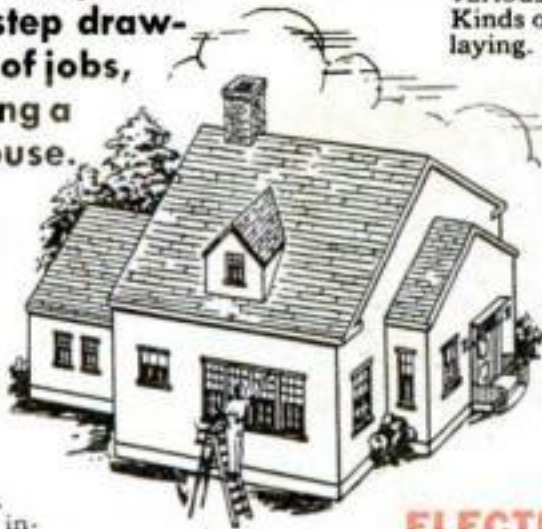
Complete information about the common metals, and the alloys—wrought iron, cast iron, steel, German silver, pewter, the brasses and bronzes, solders and babbitts—when to use, how to use, and how to work them. Hand tools and machine tools—their specific purposes, sizes, and the most detailed instructions for their use. Hints, ideas, and "tricks of the trade." How to use the engine lathe. Metal jobs and projects for home and shop, complete with bill of material, equipment needed, and a fully illustrated account of every step in the work.

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Answers every practical question about concrete, plastering, stucco, brick work, concrete-block and glass-block construction. Describes all tools, and just how to use them. How to specify materials and estimate quantities. How to build forms; mix concrete, color it, make it watertight, finish it off; how to build walls, floors, steps. All the sure methods and special ways of working by which the master mason assures good results. Everything about plastering—from small repairs to doing entire rooms. Complete instructions for stuccoing—reinforcing, methods of applying different coats, and how to obtain various decorative finishes. Kinds of brick—handling and laying. Mixing and coloring mortar. Material charts. Types of construction. Various bonds. Forming cross joints. Fire-place construction. Working with concrete blocks—building the wall, corner construction. Kinds and sizes of glass blocks. Glass-block construction—mortar, full-mortar joints, set-in-wood construction.



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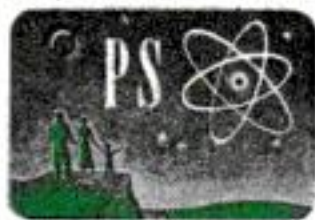
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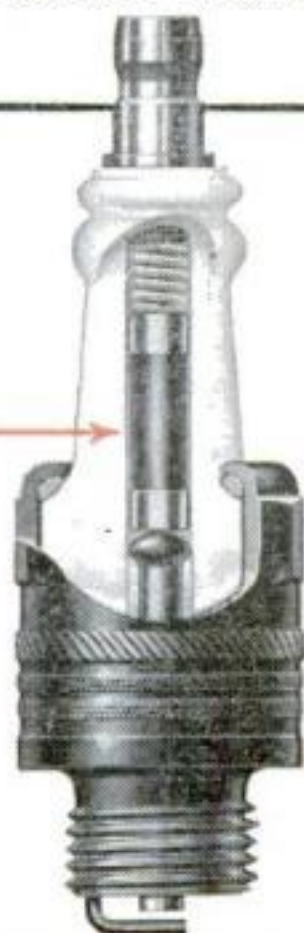
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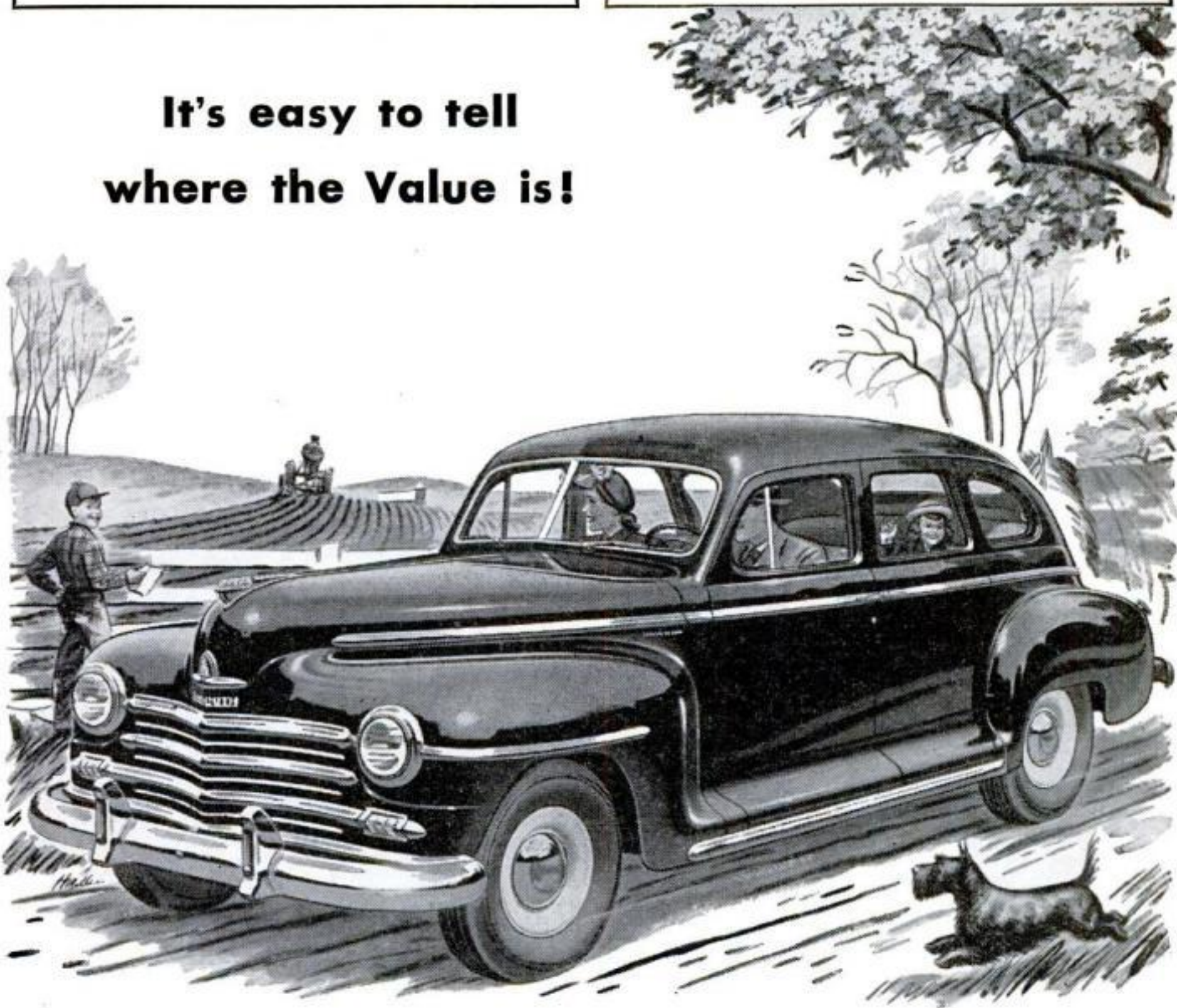
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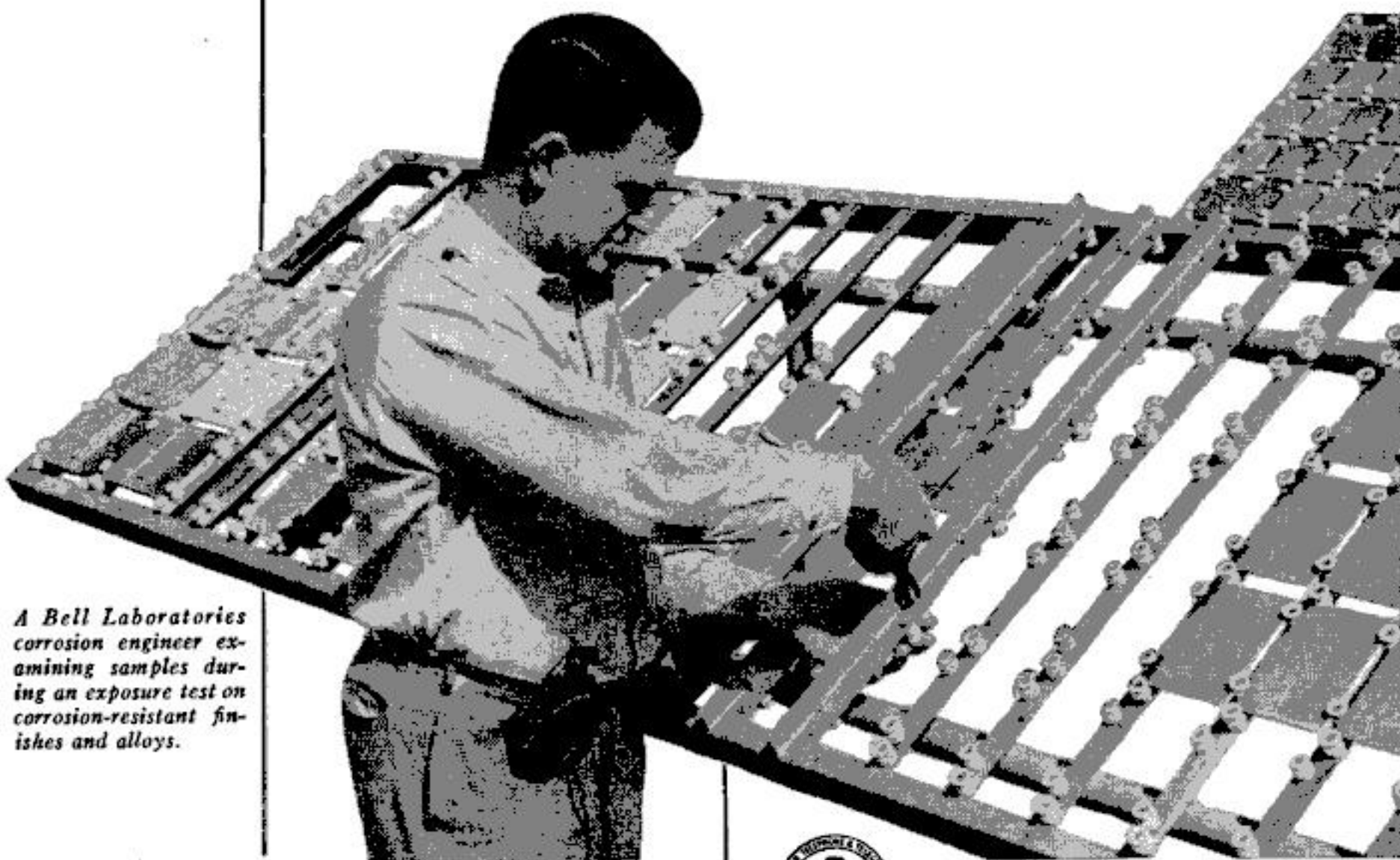
The battle of the atoms

Telephone equipment is constantly at war against invisible forces of nature which seek to take it apart, atom by atom. On all fronts, Bell Laboratories chemists must fight corrosion—an enemy able to make a telephone circuit noisy or perhaps to sever it altogether.

An example: for years lead cable had lain protected in wooden ducts. Then in certain areas something began to eat the sheath, exposing wires to moisture. Corrosion chemists of the Laboratories were called in. The corrosion, they found, came from acetic acid generated in the wood during the preservative treatment then in use. They pumped in neutralizing ammonia. Corrosion stopped. Now telephone duct wood is controlled for acidity.

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A Bell Laboratories corrosion engineer examining samples during an exposure test on corrosion-resistant finishes and alloys.

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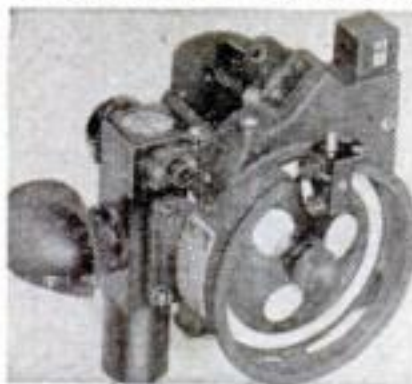
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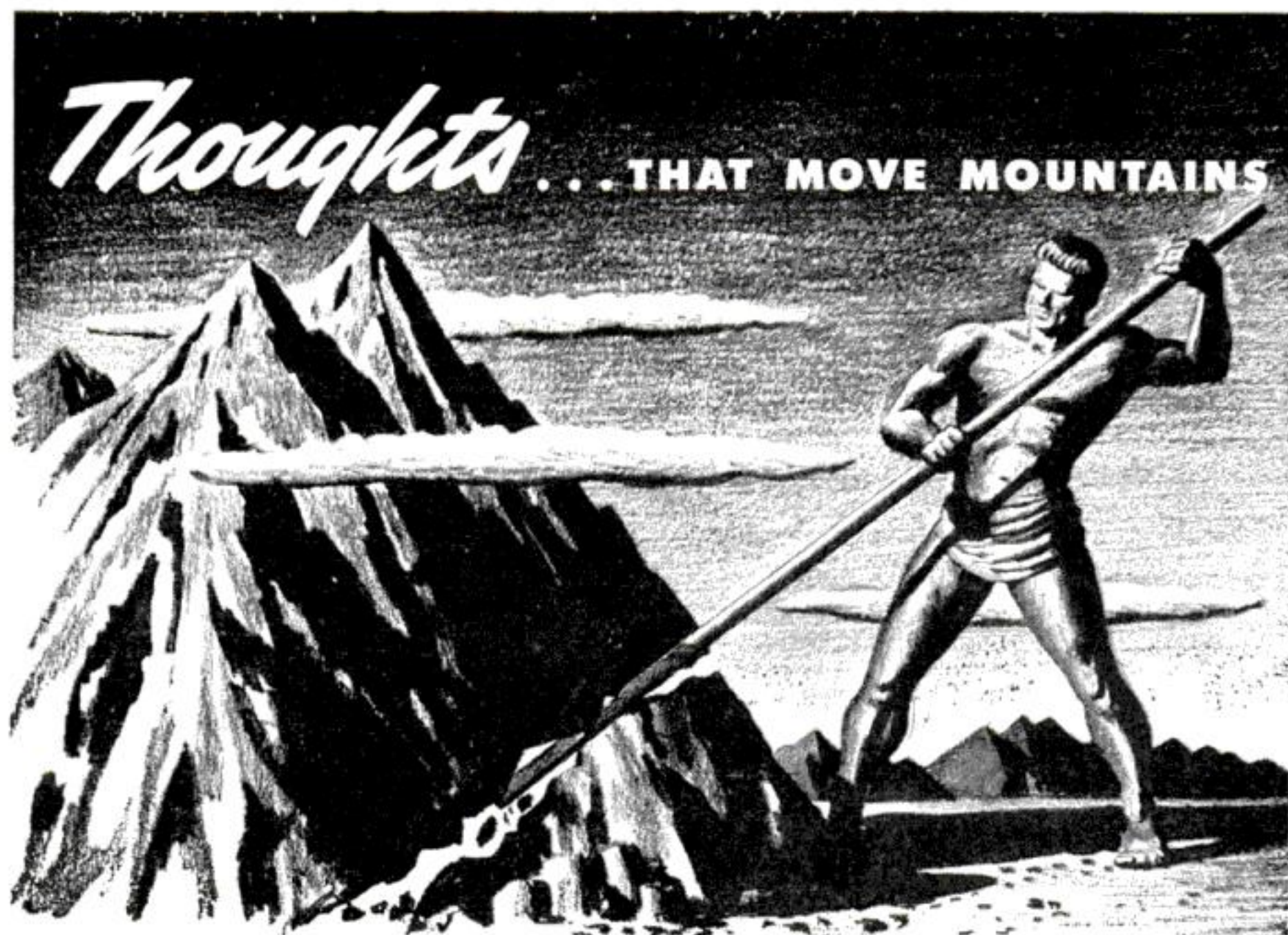
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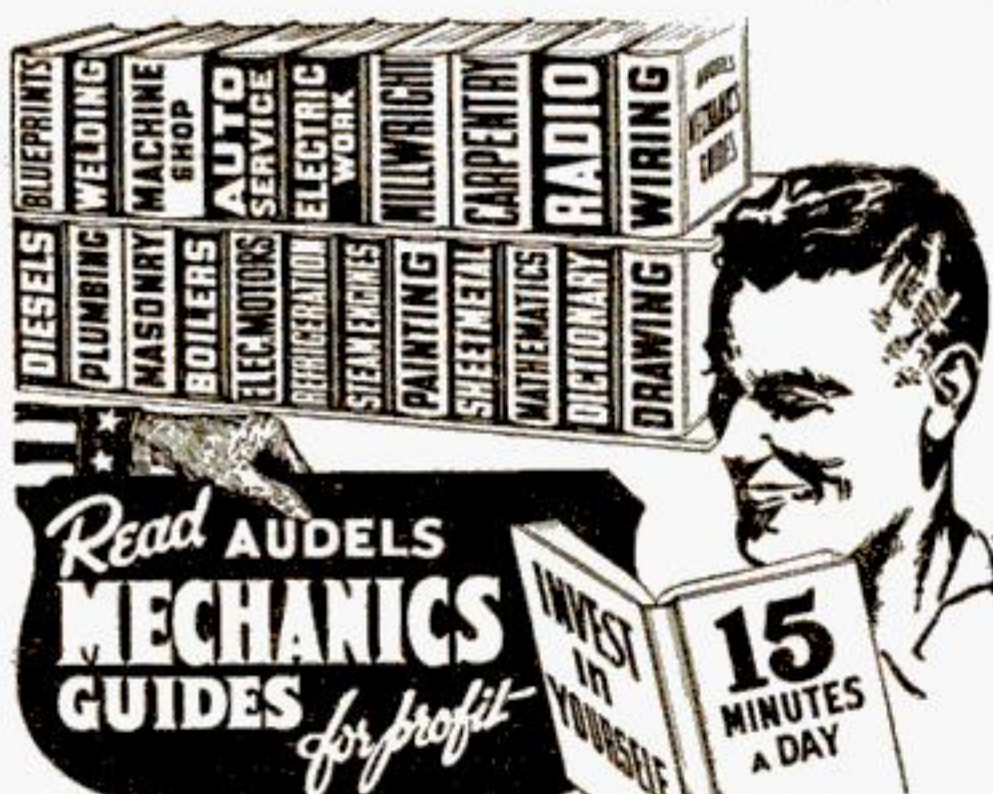
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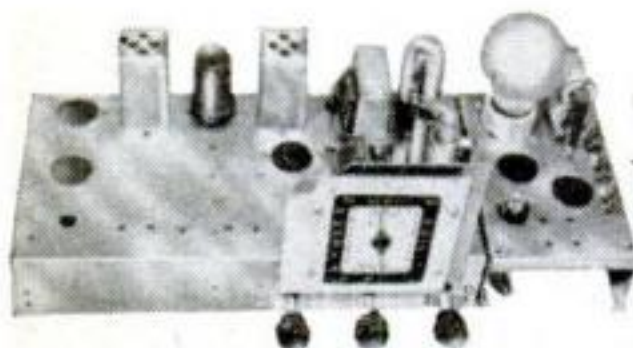
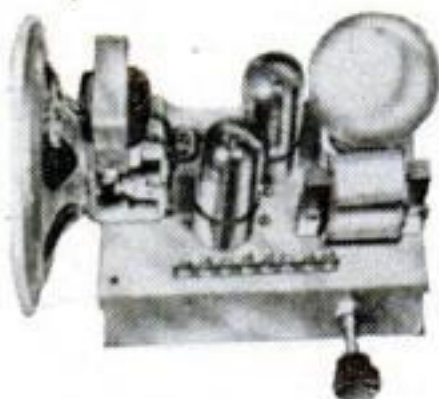
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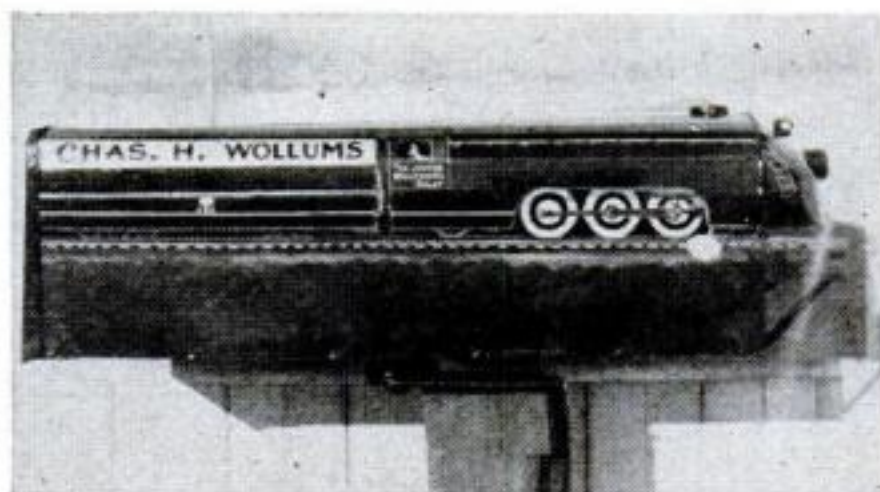
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Sir:

The letter about rural mailboxes on page 20 of the January issue recalls an experience I had some time ago. The New York Central has a crack train running between Cincinnati and Chicago known as the "James Whitcomb Riley."

My friend Mr. Wollums was an engineer on this train and lived on a rural mail route out of Indianapolis. While waiting at the depot one day to see him the "Riley" came in and at a distance the engine looked to me just like a rural mailbox on wheels. It gave me an idea. I went to building a "Riley" mailbox and presented it to Mr. Wollums for a Christmas gift.

As you will note from the photo (below), engine, tank, and right-of-way were made from a conventional rural mailbox, the rear end of the tank being the mailbox door. I constructed a trunnion under the box with two ball-and-socket stops at 180° apart, so that when the engine was turned toward the country road the carrier would have to turn it half way around to insert the mail. This way, the folks could see from a distance whether any mail had been left in the box.



After completing the box, I found out to my sorrow that only white or aluminum boxes were permissible. On account of this box being such a novelty, however, the postal authorities gave my friend permission to put it on the post.

O. C. THOMPSON

West Lafayette, Ind.

Oddly enough, the Post Office Department now permits the use of paint but is

INVENTORS

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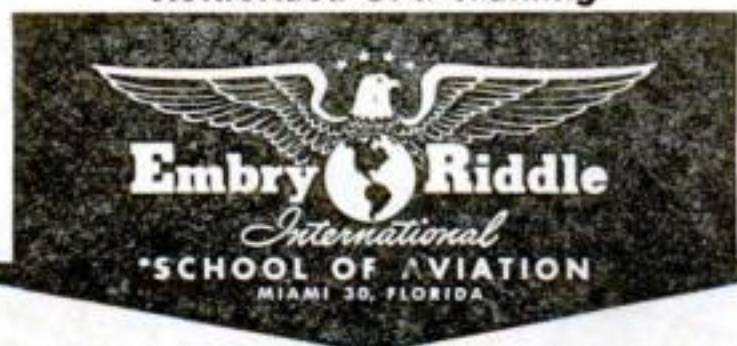
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adamant on refusing to permit the use of any boxes other than the two standard sizes and shapes it approves.

Up-to-Date Science

Sir:

This is my first letter of this nature to congratulate you on first-hand information. I am somewhat of a science reader, and I happened to be glancing through a section of the Sunday paper and there was an article on the lowly fly and his method of producing inertia, or stability, as in the spinning gyroscope. Being interested in such, I knew I had read the same explanation before somewhere. Well, being a hoarder of PS, out come my back issues and lo and behold there in the August 1946 issue was the same story of the fly's inertia secret. The up-to-date science that appears in PS is O.K. with me, so keep up the good scooping.

MICHAEL W. SCOW

Wilkes-Barre, Pa.

Library for the Layman

Sir:

I enjoy PS so much that there are few suggestions I could make to improve it. Except for politics, economics, etc., it is a very good way to "keep up with the world."

The color photos of the XB-45 and XB-46 were first-rate. The only thing that could make them better is heavier paper. PS is a modern age library for the layman.

FRED C. MASSA

Phila., Pa.

Not So Dumb

Sir:

After reading the article "Box Reflectors for Flood Lamps Increase Light," I am more than convinced that either the editors are not thorough in investigation of articles submitted to them or that they think their readers are awful dumb.

I have never been able to use more than 3 No. 2 photo flood lamps on a single house circuit that was fused at 20 amperes. The writer of the article suggests using his box reflectors with 6 No. 2 photo flood lamps, which may be all right anywhere but on an ordinary house circuit.

Will you tell Mr. Jack Mellinger that 3 single clamp-on reflectors of the usual \$1.75 variety will give more than ample lighting



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for any sort of a photograph that even a box camera can take with medium-type film.

JOHN F. SLAVINSKY

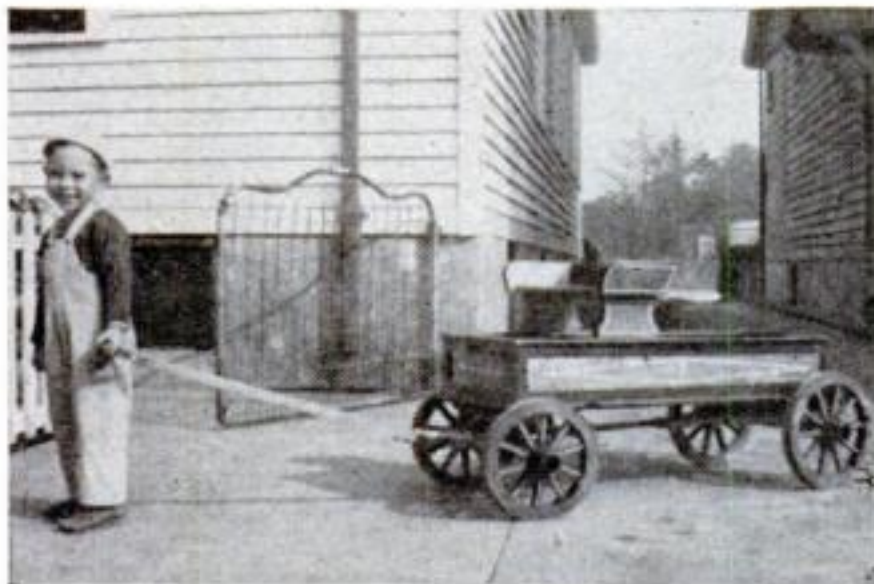
Rochelle Park, N. J.

No reader familiar with flood lamps is likely to connect six to a single outlet, and the article did not suggest that this be done. Since the No. 2 lamp draws 4.4 amperes, three will take 13.2 amp., well within the capacity of the 15-amp. house fuse. (If Mr. Slavinsky uses 20 amp. fuses, he is over-fusing.) The two three-lamp units should be plugged into separate house circuits. As for finding three lamps "more than ample," PS wonders if reader Slavinsky has ever tried taking color pictures with such a setup.

From Worksheet to Wagon

Sir:

Here's a picture [below] of my son with the wagon I have built from the plans in your magazine ["Bantam-Size Farm Wagon," July '47 p. 158]. The wagon's underpart is made from white oak and brass. The wheels are made from mahogany, teak, and birch, with steel rims and brass bushings. The woodwork is varnished and striped with light blue paint.



The wagon sure makes a hit with the kids. I am now working on an electric jeep, aluminum-covered, with brake and clutch.

JOSEPH JOHNSEN

South Ozone Park, N. Y.

PS Gets Around

Sir:

... I think more of PS than any magazine I could get over here because it explains and gives details of metal-work, wood-work, toys, etc., so any chap with a little knowl-

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R. M. HILLOCKS

Dundee, Angus, Scotland.

Switch the Switches

Sir:

Your article "Switches Act as Door Lock" in your January '48 issue, page 219, describes a method of connecting 12 SPDT switches in series to act as a combination door lock. But with the type of switches shown, the caps could be easily removed, and the binding-screws could be connected by a temporary jumper wire, causing the device to open the door. . . .

ROBERT HEILMAN

Clinton, N. J.

Radio toggle switches, whose terminals would be inaccessible from the front, would be better, but the switches shown can be fairly foolproofed by simply running dummy wires to the dead terminals. Also, the external leads, shown connected to the first and last switches for clarity, should be wired up in some less obvious combination.

Doppler Was No Dope

Sir:

In your article "Rocket's Flight Kept in Sight," page 130 of the January issue, you make the statement: "This same thing (change in frequency caused by movement of the transmitter) happens to all kinds of waves—light and sound as well as radio."

I have always been under the impression that light waves were not influenced by movement of either the transmitter or the receiver; in other words, that light waves have no Doppler effect. . . .

M. M. McLEOD

New York, N. Y.

The speed of light does remain constant, but the Doppler effect is caused by a change, not in the velocity of the waves, but in their frequency, or number of vibrations per second. Some stars, for example, are moving away so fast that the resulting change in the frequency of their light makes them appear red. The amount of this "red shift" tells astronomers their speed.



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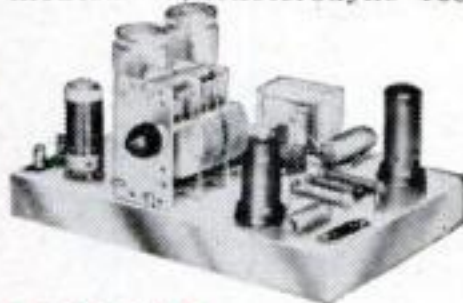


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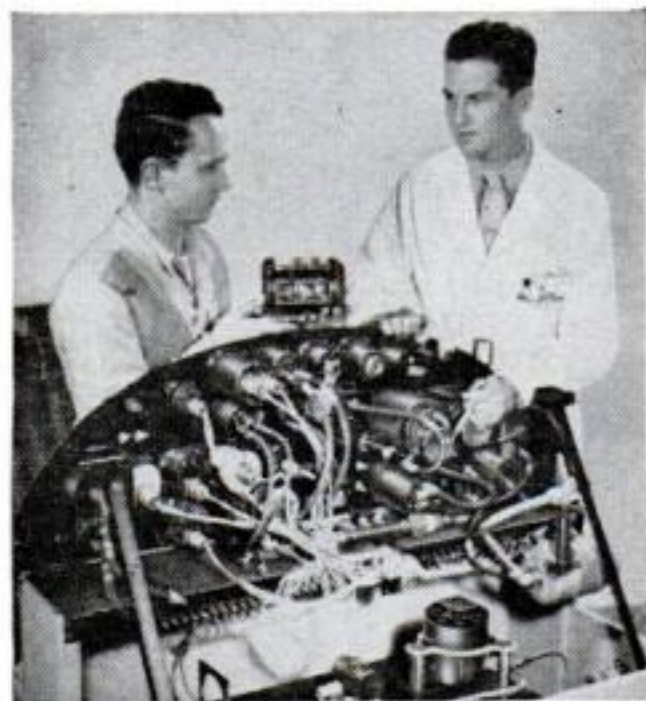
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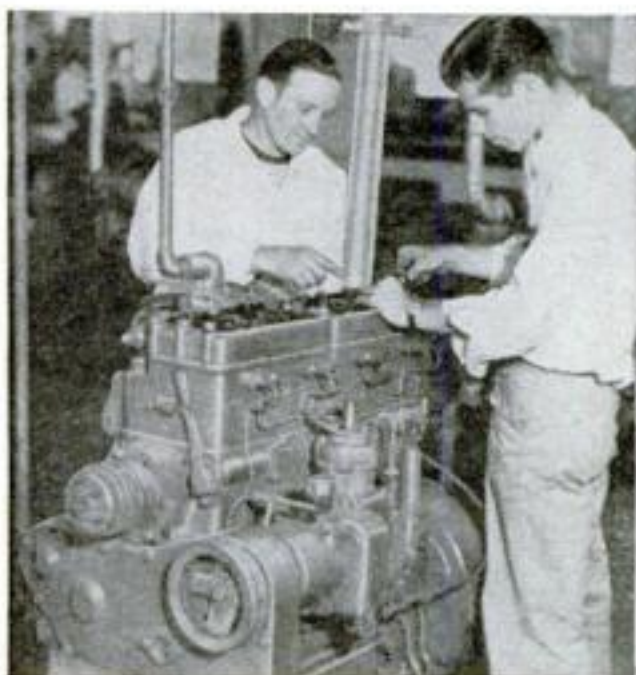
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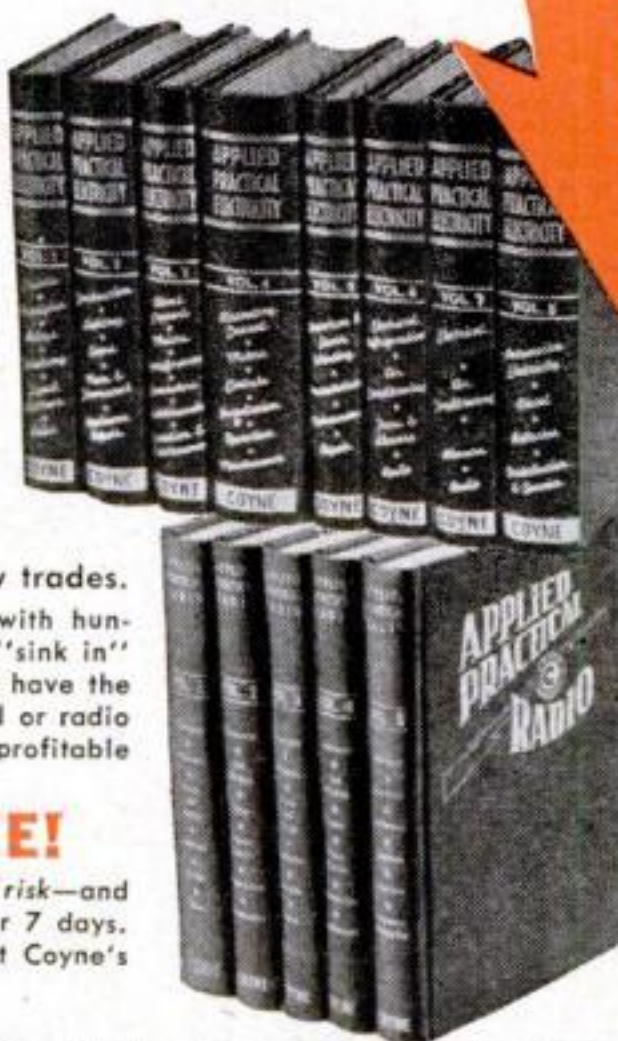
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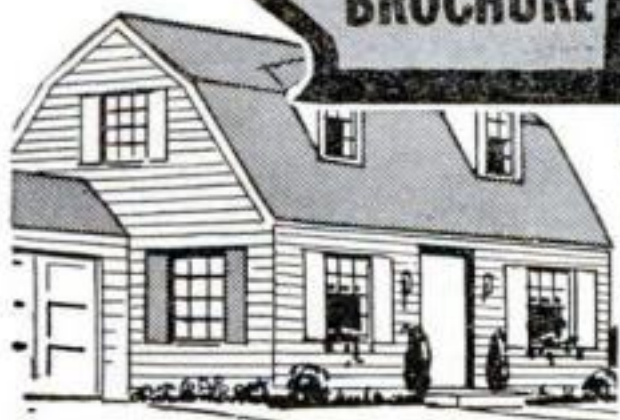
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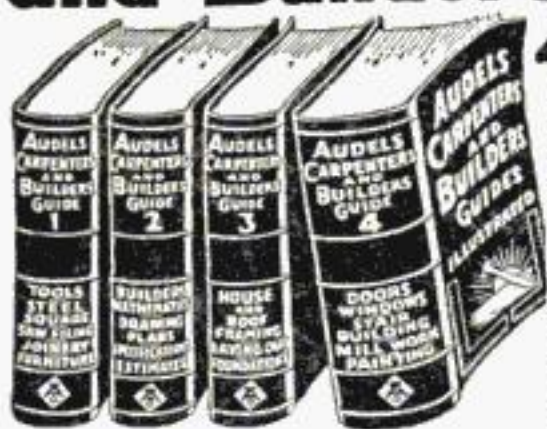
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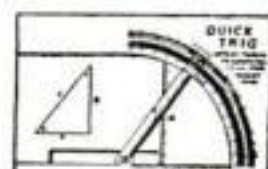
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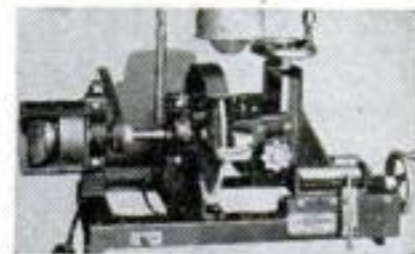
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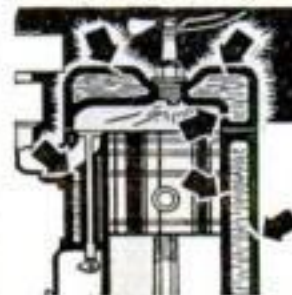
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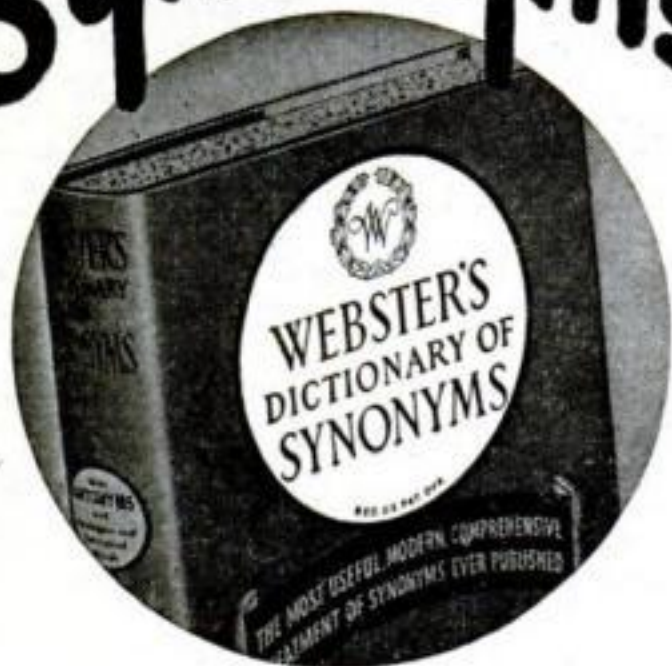
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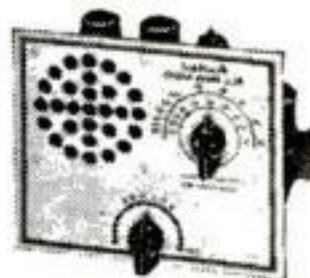
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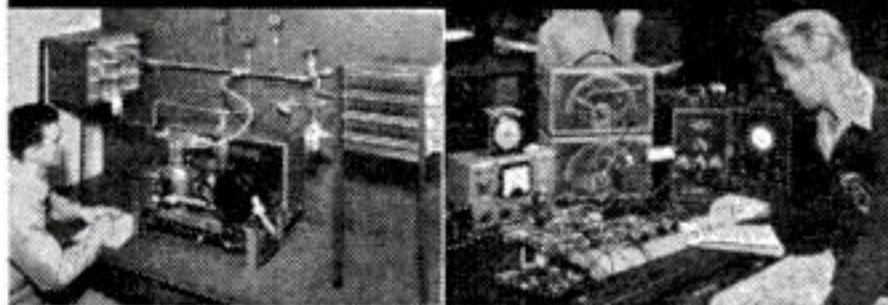
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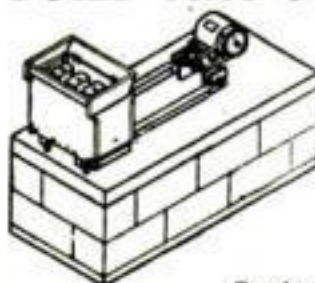
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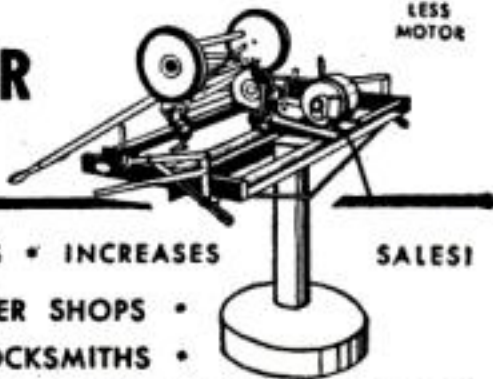
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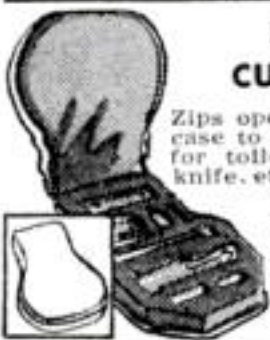
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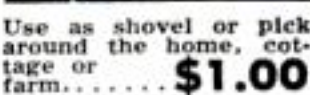
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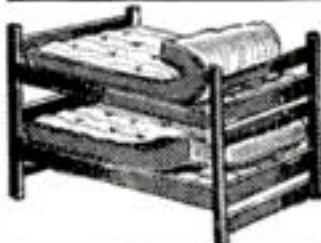


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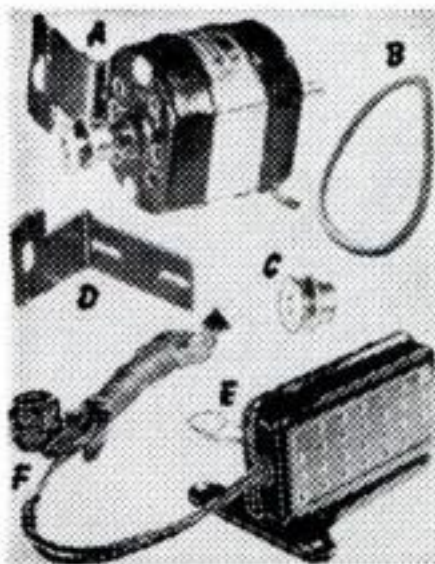
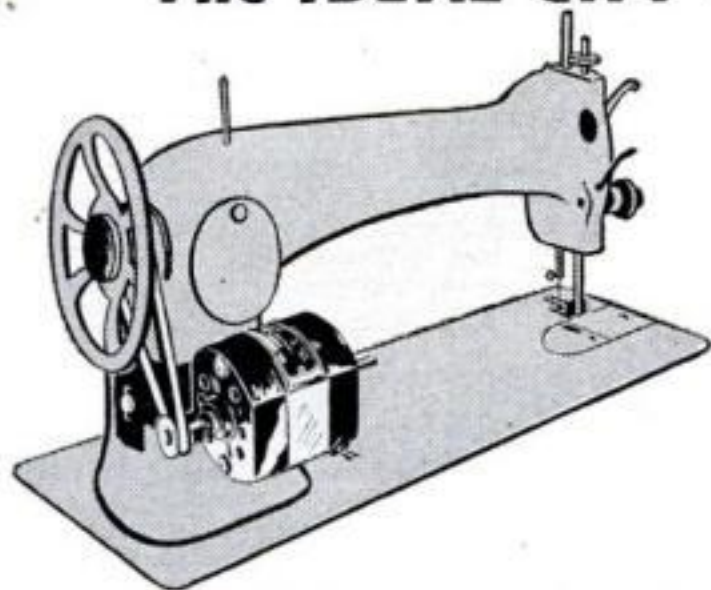
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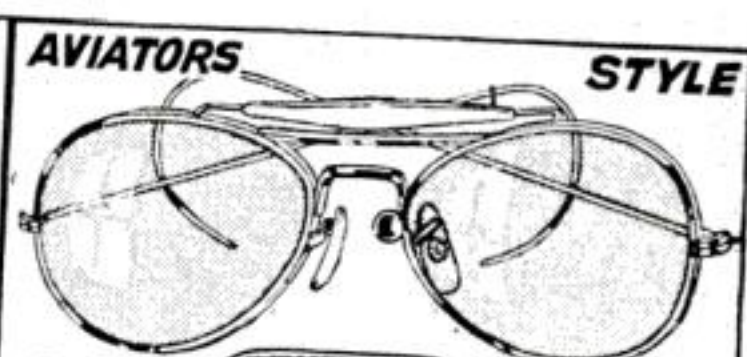
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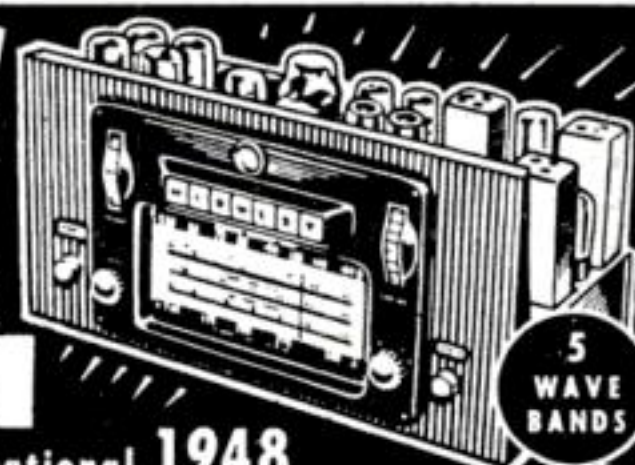


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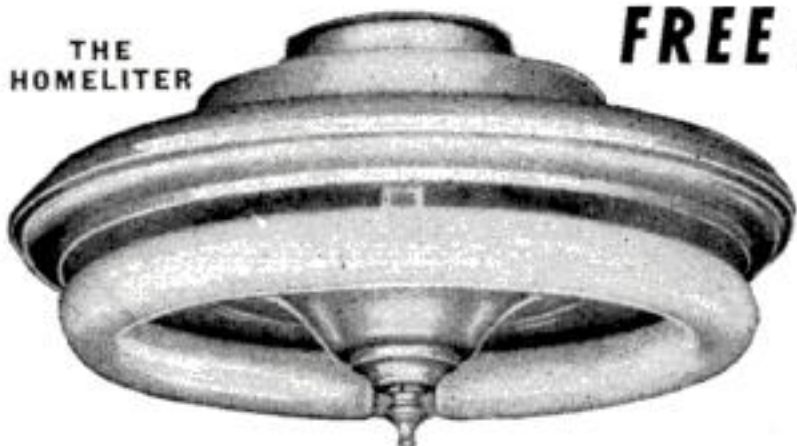


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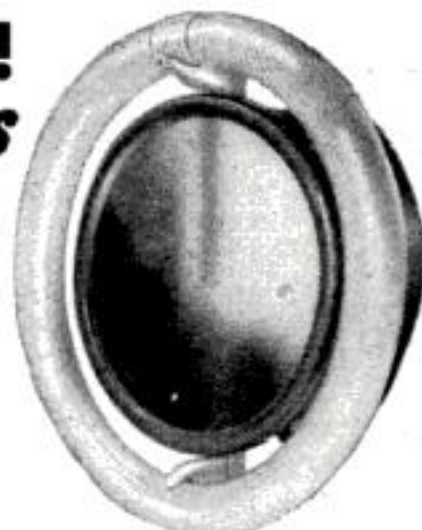
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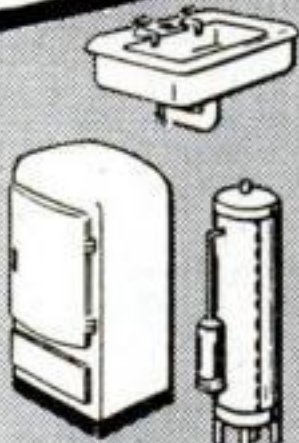
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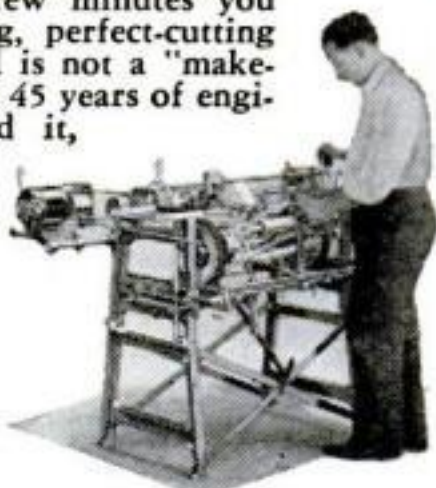
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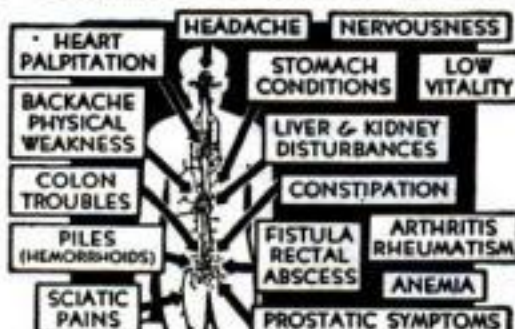
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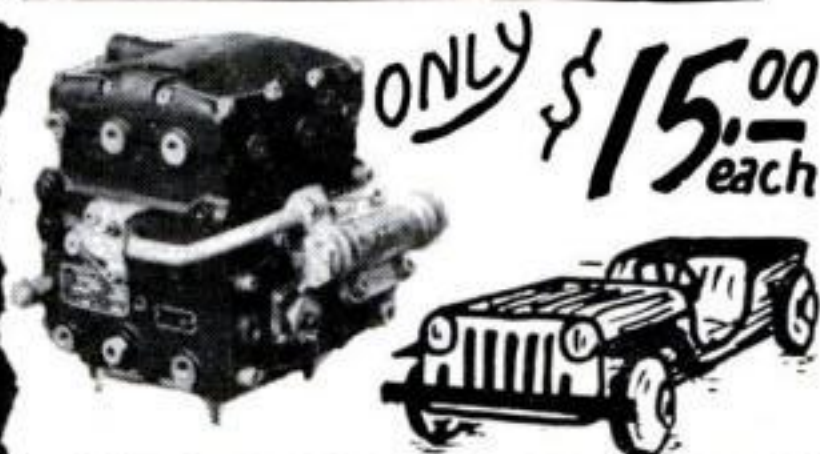
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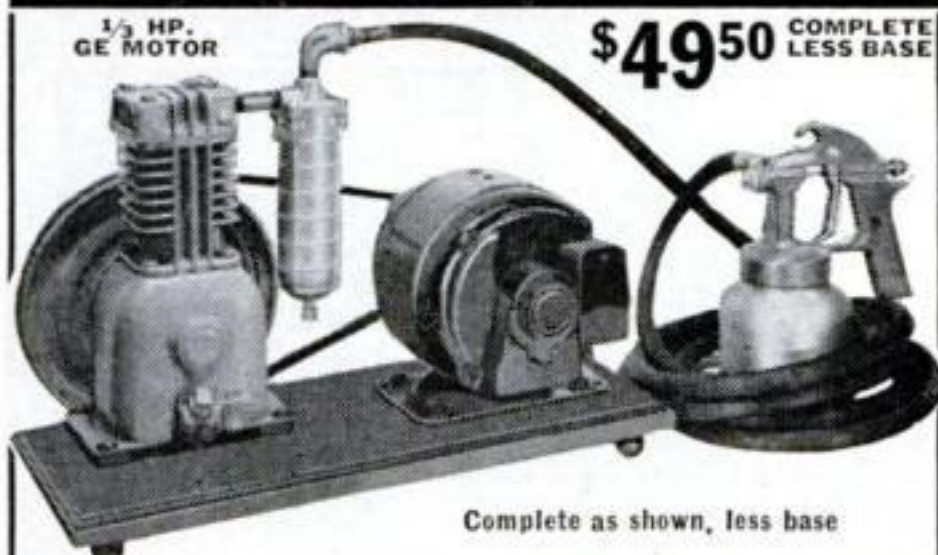
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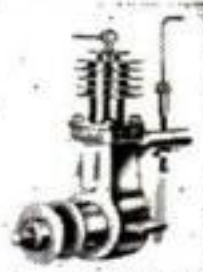
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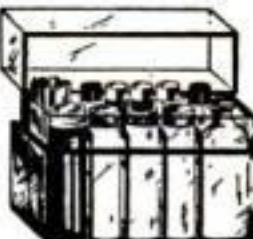


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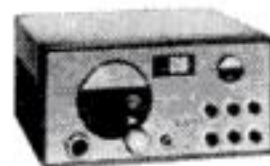
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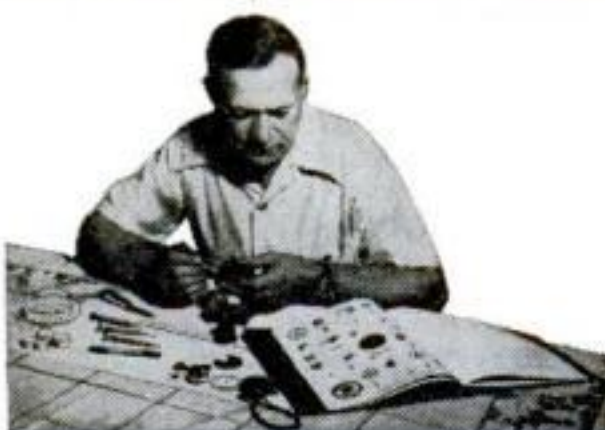
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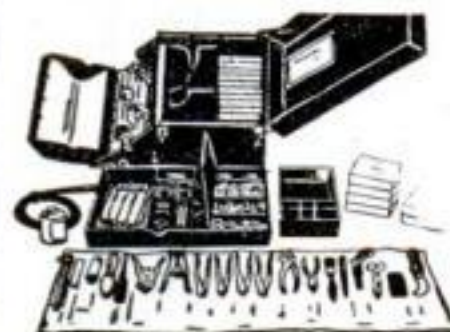
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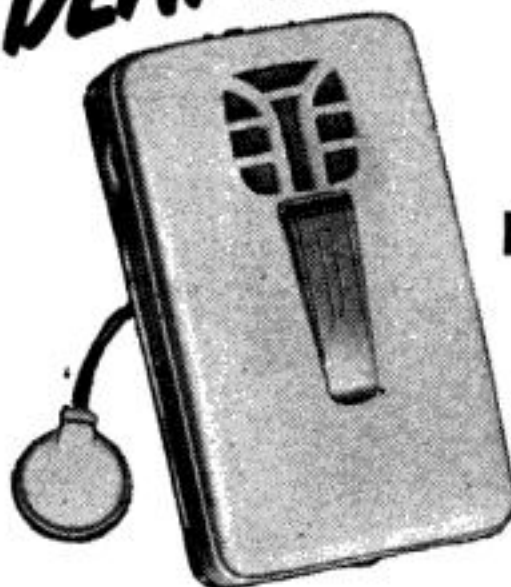
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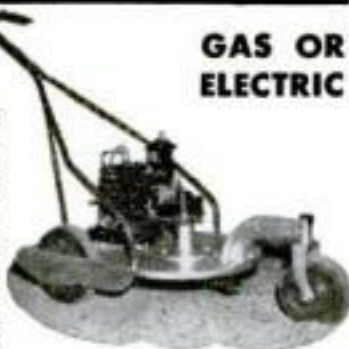
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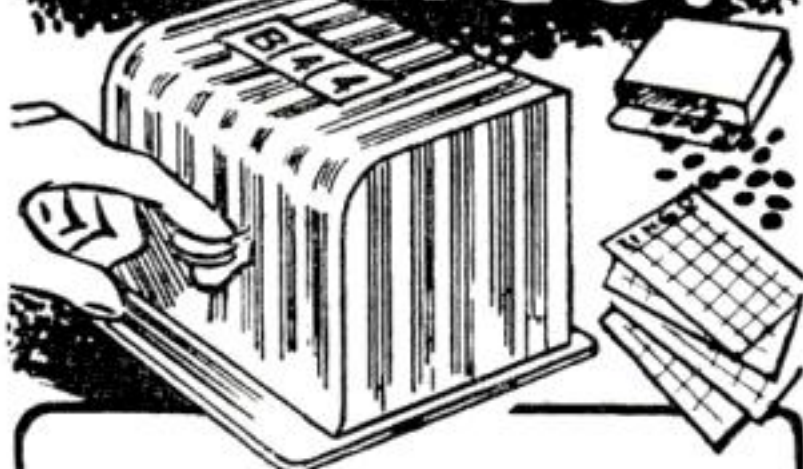
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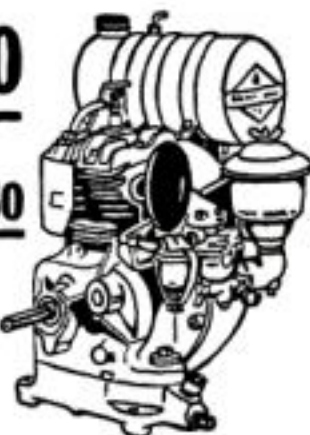
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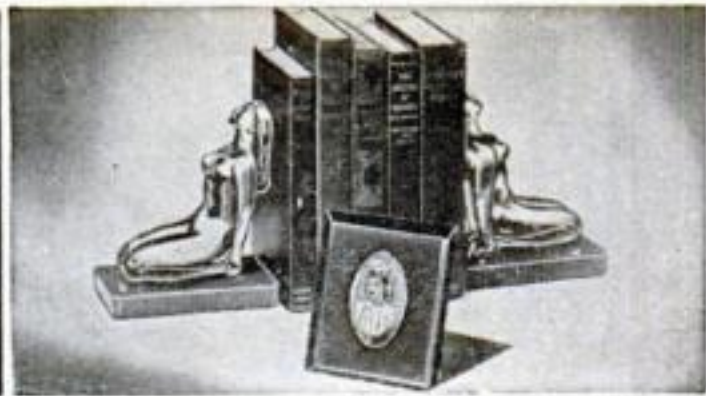
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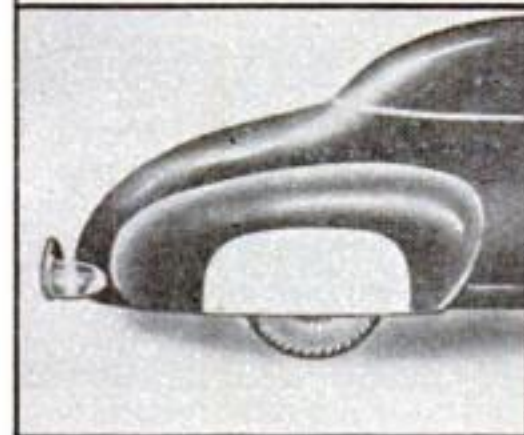
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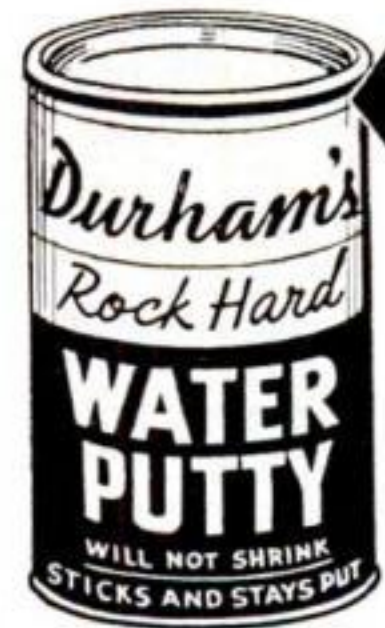
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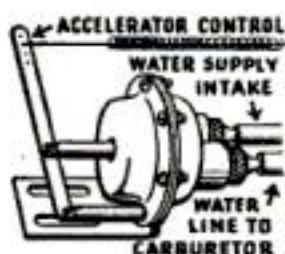
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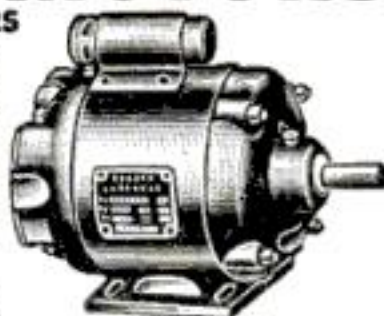
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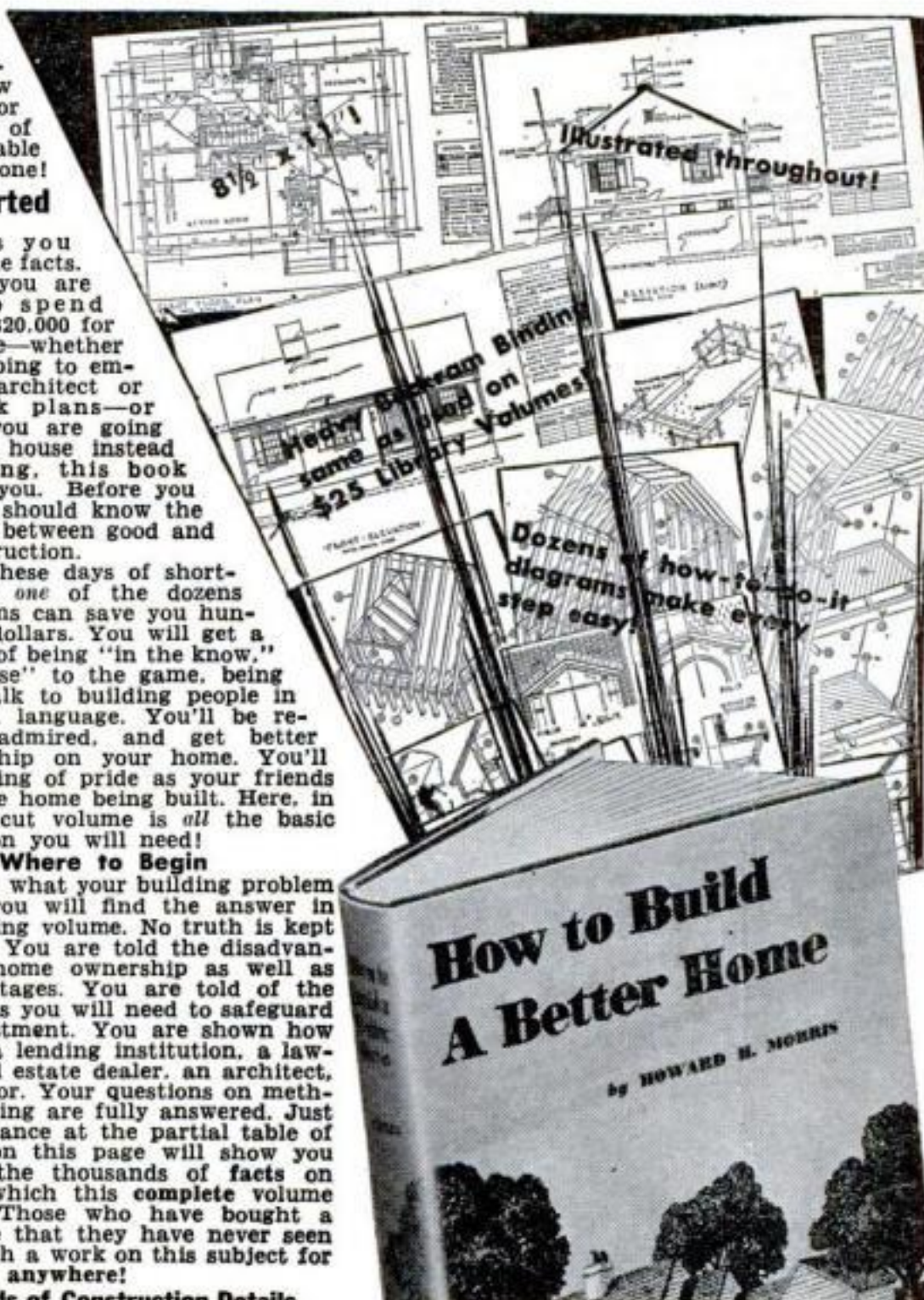
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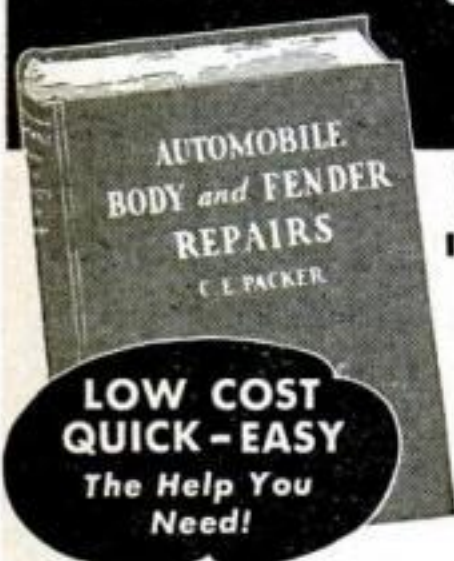
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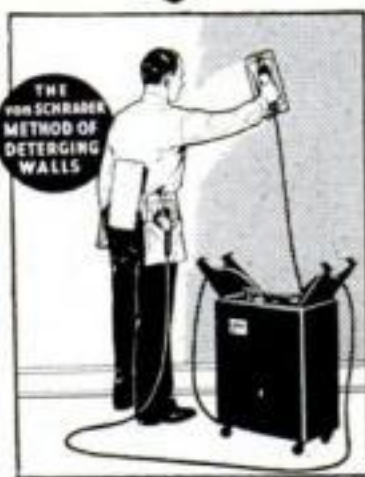
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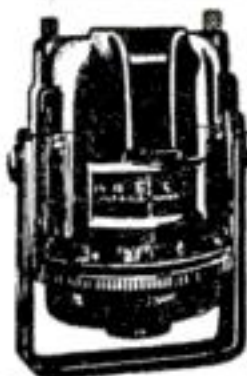
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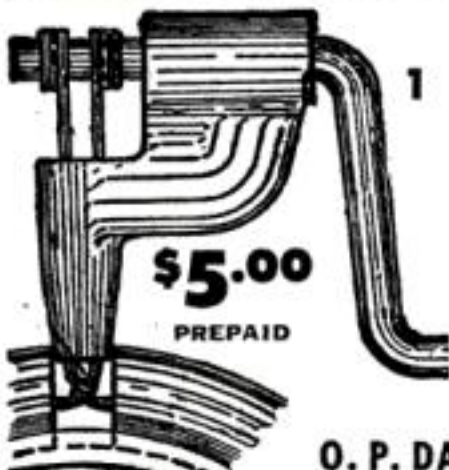


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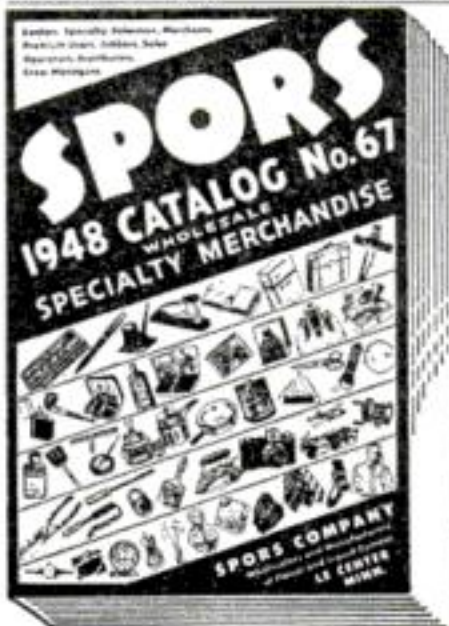
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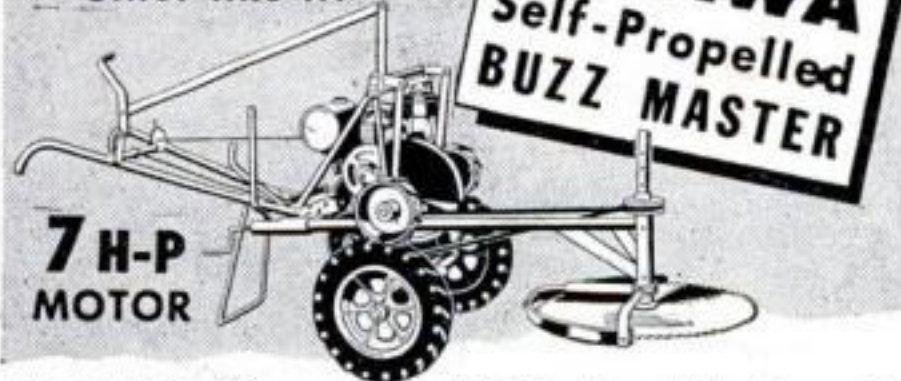
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FLAT Rate repair manual for Harley-Davidsons. Gives flat rate charge for every operation. Every dealer, owner, mechanic needs this new book. \$2.00 postpaid. Clymer, Dept. B-FR, 2125 W. Pico, Los Angeles 6, Calif.

INDIAN Riders! Equip your "Chief" with Harley jiffy-stand. Special bracket, easily attached—\$3.25. Stand \$4.50 extra. Cycle Specialties Co., Box B, Havana, Fla.

PROFESSIONAL Midget racer, motorscooter, midget roadster, midget motorcycle. Plans, specifications contained in illustrated handbook, 25c. Directory bargain priced used motors, motorscooters, Servicycles, etc., included free! Midwest, 3839 Drummond, Toledo, Ohio.

5 AVIATION

GIANT Kites. Only \$30. Fraction government cost. 10x14 ft. Double tier. This monster tows cars, skiers, skaters, canoes. Lifts light persons, antennas, advertising, cameras. Pleasure, Profit. Great-Northern Mart, North Adams, Mass.

VETERANS: Flight training under the G.I. Bill. Private, Commercial and Flight Instructor Ratings. Write for information. Gottschalk School of Aeronautics, Adrian, Michigan.

AIRCRAFT sketches, any plane, you specify. 12 for \$1.00. Glen Winterscheidt, Beneca, Kansas.

FLIGHT Engineers Manual (Zweng) \$4.00; AAF Sextants \$12.50; Aerial cameras \$175.00; Hamilton AAF Master navigation watch \$71.50; (Free folder). Pan American Navigation Service, 12021-D3, Ventura Blvd., N. Hollywood, Calif.

PROPELLERS—2 & 3 blade, for snow-ice sleds, boats. Catalog. Standard Aircraft, Box 387, Ft. Worth, Texas.

JET Propulsion experiments. New design. Drive bicycle. Circular on plans. Rush name. Maupin, Tipp City 30, Ohio.

7 ELECTRICAL SUPPLIES & EQUIPMENT

LAMPS—All parts to build or repair. Illustrated catalog 10c. Gyro Lamps, 5416-B, Chicago 40.

LELAND Electric generators, 2.5 KVA. 120 Volt, 60 cycle, single phase with radio filter. Turn at 1800 rpm, producing 2500 watts. \$125.00 freight prepaid. Hopfer & Company, 3124-B East 14th Street, Oakland, California.

LAMPS—Build own originals, parts wholesale any amounts. Catalogue 10c. Brown Lamp Co., Box 501 Wellston, St. Louis 12, Mo.

FREE Catalog motors, welders, welding supplies, generators, fencers, electric mowers, freezers, other electrical items. LeJay Company, Minneapolis, Minn.

LAMP sockets, mogul sockets, three way switches, tumbler switches, receptacles, cordsets, electrical repair parts, lamp parts, etc. Catalog 10c. Gearon Company, 6405H North Oakley, Chicago.

ELECTRIC pencil: Engraves all metals. \$1.00 postpaid. Beyer Mfg., 229-C Dixon, Uniontown, Penna.

NEW Double voltage generator 115 volt 1200 watt A.C., S.P. & 28.5 volts x 200 Amps. D.C. excellent for welding generators, lighting plants & experimental work. Shp. Wt. 60 lbs. No conversion necessary. results of huge purchase. Your cost only \$19.75 f.o.b. Surplus Sales, 24th St. & Cudaback Ave., Niagara Falls, N. Y.

SURPLUS New electric hand drills 1/4 capacity, A.C.-D.C.-60 cycles 110 Volts. Year guarantee. Special \$14.98. Leonard, 1300 Douglas, Los Angeles 26.

1/3 HP GE AC 110v, 1725 RPM. Newest motors, \$15.95. Domestic Electric, 118 E. 28th St., New York City.

8 WELDING, SOLDERING

WELDER—New portable champion special Transformer Welder; 110/220 volts, AC. 8 heat stages. Welds, brazes, solder, cuts all metals. Complete with electrode holder, helmet rods, carbons, fluxes, cables. Also special Flame Weld Torch. Easy to use. Full directions. Splendid for shop, farm and home repairs. Guaranteed. Only \$27.50. Money back guarantee. Also resistor model. Now \$14.95. Magic Welder Co., 239 PS Canal St., New York, N. Y.

ACETYLENE Welding generator. Build it. Complete Plans \$1.00. P. O. 1325, Brownsville, Texas.

RUBYFLUID soldering flux, send \$1.00, get one pint liquid and 1/2-lb. paste flux with pamphlet "How to Solder." Ruby Chemical Corp., Columbus 8, Ohio.

A.C. WELDERS. 110 V, welds 1/2" steel \$29. Morris Welding Service, 1850-B State, Schenectady 4, N. Y.

WELDERS for all requirements. Free catalog. Write Hobartweld, Box P-485, Troy, Ohio.

"BUILD-UR-OWN" Portable Arc Welder. Save \$350. Easy with Hobart Generator plus auto engine. Free instruction book. Write Hobart Welders, Box P-484, Troy, Ohio.

10 MACHINERY, TOOLS, SUPPLIES

DRILL GRINDER—Grinds drills to factory accuracy. Calipers with direct reading scales. Circle cutters. New Tool grinder. Lowest prices. Free literature. Factory, 811-A East 31st, Kansas City 3, Mo.

BARGAINS in war surplus. Hydraulic Transmissions, switches, motors, geared speed reducers, Aviation Instruments, etc. Delta Sales, Dept. S-1, P. O. Box 968, Shreveport, Louisiana.

POWER Tools. Build your own with Lewis Castings. Save up to 80%. Complete castings, materials and blueprints supplied for 23 woodworking and metalworking tools. Free catalog. Write today. Lewis Machine Tool Co., 3217 Union Pacific Avenue, Dept. S, Los Angeles 23, California.

WAR Surplus special: Big 50 lb. box popular size bolts, nuts, washers, screws, clamps, etc. \$6.85. War Surplus Co., Box 910, New Brunswick, N. J.

MODERATELY Priced! Immediate delivery! Nationally known Portable Electric Sander, Woodworking power tools, Shaper, bandsaw, etc. Paint sprayers, Armand grinder, For schools, home workshops, cabinetmakers, farmers, garages, repair shops, others. Postcard brings free illustrated bulletin. H. Saltzman Co., Dept. G, 118-14 83rd Ave., Kew Gardens 15, N. Y.

SPRING steel adjustable tool chips. Keeps your tools and parts handy. Send 10c for sample. Baron Products, 20014 Rogge, Detroit 12, Mich.

BAND SAW—Bench type for home workshop—Ideal for hobbyists—Cuts wood, metal, plastic, leather, etc. Special \$14.95 —Factory to you—Lowest priced band saw on market—Thousands in use. Free circular. Woodcraft Tools, Inc., 147 E. Lake, Minneapolis, Minn.

CONCRETE Block machines \$39.50 up. Catalog free. Concrete Mold Company, 5466 Gravois, St. Louis, Missouri.

CHUCKS. Independent, Universal. Threaded 1 1/2"-8 for South Bend, Atlas, Logan, Clausing, Craftsman Lathes. Also other chucks to 16". Top value. Free Literature. Westcott Chuck Co., 3700 Walnut, Oneida, N. Y.

"BUILD-UR-OWN" Combination AC welder and AC Power plant. Welding, plus power to run tools, lights, motors. Portable. Save \$350. Easy with Hobart Generator plus auto engine. Free instruction book. Write Hobartweld, Box P-486, Troy, Ohio.

RUST-FREE—Keeps tools, photographic equipment, fishing tackle, etc. from rusting without oily coating. Employs new dehumidifying principle. Satisfaction guaranteed. Order today. Fifty cents. Rust-Free Sales, 1308 Girard, Middletown, Ohio.

ANGEL plate 3"x3x4" ribbed precision ground \$3.50. Rough casting 95c. Model Tool Service, Rockfalls, Ill.

SPEED Reducer—New variable speed transmissions. 2 Hp., continuous control either direction 0 to 30%. \$14.80. Engineering Research Laboratories, 520 South Boulevard, Norman, Oklahoma.

SHEBEL Saw Filer, \$7.50. Files all saws. Free trial. Circular, 730A So. 2nd St., Milwaukee 4, Wis.

DRILL GRINDER for twist drills \$2.95. See ad on page 278.

14 BOATS, OUTBOARD MOTORS, ETC.

FULL size, cut to shape boat patterns, blueprints, 7 1/2—38 feet. Illustrated "Build a Boat" catalog, 10c (coin). "How to Build Boats" book, \$1.00. Cleveland Boat Blueprint Co., Dept. A-77, Cleveland, Ohio.

PLYWOOD Rowboat and Motor Boat K.D. Kits. Assemble and save up to \$57.50. Three popular models. Resin bonded, waterproof plywood construction. Easy to assemble in spare time. Write for free literature and complete specifications. C. R. Dillabaugh Boat Co., 7928 N. E. Mallory, Portland 11, Oregon.

INBOARD hulls, outboard runabouts, hydroplanes, hunting, fishing boats, boat kits, boat trailers. Huebl Boats, LeSueur, Minn.

SIGNALLING Light—New—Gov't surplus. An exceptional value for boats, construction work, scouting, etc. Powerful light with three filters and case. At a fraction of cost. Operates on 27 volts or 110 volts with transformer. While they last, \$7.95, three for \$20. Amazing Bachman's, 25 Herman Street, Rochester 5, New York.

AIRPLANE Jettison tanks—streamlined, 10 1/2 foot, tear drop shaped, 165 gallon. Of light weight lead coated steel, weighs 75 pounds. Floats over 12,000 pounds. Ideal for making trim, inexpensive boats, canoes, kayaks, dinghys, duck boats, powered catamarans and runabouts. Prices \$12.50, \$9.75 each for three or more U. S. freight prepaid. General Sales, 205 Market, Grand Rapids 3, Michigan.

OUTBOARD motors—good values, used motors. Also used parts for most makes and models. Crandall-Hicks Co., 912 Commonwealth, Boston, Mass.

LIFE Rafts, Balsa wood, \$12.00 each. Chataw Trading Company, Jefferson, Tex.

STREAMLINE stabilizing Pontoons for canoes, kayaks. Pair \$9.95. Lorenzen Industries, Niles, Michigan.

MARINE conversions for Ford and Jeep engines. Catalog 10c. Lehman Manufacturing Company, Department A, Newark 2, New Jersey.

BOAT plans and patterns A. M. Deering, N.A. 228 North LaSalle, Chicago 1, Illinois.

See display ad page 67; Boat Patterns and Kits. Marine Mart, Buffalo 7A, N. Y.

15 ENGINES, MOTORS, ETC.

RANGER Engine—Aircraft—All new in original case. 570 HP. 12 cyl. V type. Air-cooled. Engine Spec. No. 177. Complete with spark plugs. Original Government cost over \$12,000.00 each. Special offer \$200. Crated weight 1200 lbs. No C.O.D. Write for complete description. "Amazing Bachman's", Dept. PS, 23 Herman Street, Rochester 5, N. Y.

WINDING Data, listing 225 motors, single and three phase, \$1.00. Motor Data, Box 7631, Kansas City 3, Mo.

JEEP, Chrysler, Ford, Marine engine conversion parts. Free Pamphlet, Star Marine Engine Works, Oakland 3, California.

ELECTRIC Motors (new) nationally advertised brands. $\frac{1}{4}$ HP. 110 V. 60 C. 1725 RPM. Split Phase \$17.50. Condenser start \$20.50. Money back guarantee. Anderson Bros., 326 Meadowbrook Ave., Ridgewood, N. J.

MAGNETO repairing made easy, send for circular. Abbott Electric Co., Quincy, Ill.

MOTOR repair men, get our bulletins on stator winding tester, and A. C. motor winder. Motor Industries, Quincy, Illinois.

MOTORS, generators; any H.P.—voltage; AC or DC; Rebuilt. Year guarantee. Roberts Electric, 7232 Madison, Forest Park, Illinois.

WELDING generator, 150 ampere \$47.50. $\frac{1}{2}$ horse 1725 RPM AC Motor \$24.50. Butler, 1885 Milwaukee, Chicago.

MOTORS! $\frac{1}{2}$ h.p. d.c. converted to a.c. All new. High speed 110 volt 25 or 60 cycle, single phase, ball bearing motors. Actual value about \$75.00. Now \$15.00 each or 3 for \$40.00. With forward and reverse switch \$19.50. 3 for \$50.00. Can be used in any position. Immediate delivery! No C.O.D. "Amazing Bachman's", 27 Herman St., Rochester 5, N. Y.

18 BODY-BUILDING COURSES

ATHLETES, swimmers, tumblers—teenagers—co-operate with amateur photographers. Free information. Hobby Directory, South Orange, N. J.

BARBELLS! 95 pound set \$9.80; extra plates 9c pound. Send for free course and catalog. Bur Barbell Co., Lyndhurst, N. J.

BAR-BELLS, Dumbbells, Exercise equipment, Courses, Free booklet. Good Barbell Co., Reading, Penna.

19 SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

SKI-TOWS, Portable. Auto-powered. 500 ft. long. Pulls you both ways. Up, level or downhill. Set up in 20 minutes. Only \$125. Send card for particulars. Great-Northern Mart, North Adams, Mass.

SHOTGUNS, Rifles, Revolvers. Over 500 Modern, Obsolete, Also Cartridges. List .10 coin. Ed Howe, 26 Main Street, Coopers Mills, Maine.

5,000 BARGAINS, firearms, binoculars, war relics, catalog 40c. Smith Museum, Runnemede, N. J.

WADERS: Gloves, hood all-in-one for one price \$2.95 C.O.D. J. Glass Co., 1634 S. Main St., Los Angeles, Calif.

ANTIQUE-modern pistols, revolvers, swords, daggers, armor. 160-page illustrated catalog 50c. Robert Abels, 860 $\frac{1}{2}$ Lexington Avenue, New York 21.

SHOTGUNS, Rifles, Revolvers. Over 500 Modern, Obsolete, Also Cartridges. List .10 coin. Ed Howe, 26 Main Street, Coopers Mills, Maine.

CLOSING Out:—435 antique Firearms:—35,000 coins, relics, cartridges, swords, flintlocks, carbines, minerals, antiques.—Illustrated Catalog 25c. Heike, Wenona 2, Ill.

20 FIELD GLASSES, TELESCOPES, ETC.

TELESCOPES, Binoculars, Microscopes, —big bargain catalog free. Brownscope Company, 24 West 45th Street, New York.

7x50mm PRISM Binoculars, Zeiss design. New, save 75%. Sacrifice, \$49.50 plus tax. DuMaurier Co., 274 State, Elmira, N. Y.

GOVERNMENT Surplus — Telescopes, binoculars, lenses, prisms. Send stamp for "Bargain" list. Hobbyist lens set—Magnifiers, reducing lenses, positives, negatives. 10 piece set, \$1.00 — G. Jaegers, 123-26 Rockaway Boulevard, South Ozone Park 20, New York.

POWERFUL Astronomical telescopes easily made. Perfect lenses and instructions; 100 power \$3.00, 100 and 200 power \$4.00, 100, 200 and 400 power \$6.00. Clear vision and full power guaranteed. Instructions alone 10c. Suffolk Science Service, Manorville, N. Y.

VARIABLE Density filter for binoculars assures comfortable viewing under all conditions. \$1.50. Ross, Section B, 68 West Broadway, New York.

ASTRONOMICAL Mirrors — Made to order. Herman K. Stump, Winchester, Indiana.

POWERFUL astronomical Refracting telescope, equatorially mounted, all metal, two eyepieces, \$16.50. Bluhm Optical Lab., 1270 E. 83rd, Cleveland 6, Ohio.

ASTRONOMICAL telescope lens kit, 100x—200x—400x powers \$3.00. Microscope lens kit, 100x—200x—400x—800x \$2.00. Plans included. Pfeegor Optical Company, PS-4, Sunbury, Pa.

21 OPTICAL

NIGHT-driving bugaboo ended. Amazing new Nite-Lite driving eye-glasses stop blinding headlight glare of oncoming cars. See everything more clearly. Colors look bright and natural. Issued to police of many states and cities. Fulvue lenses with goldplated frames—\$8.50. C.O.D., check or money order. Orders Shipped postpaid anywhere in United States. Nite-Lite Sales Company—Dept. 2, St. Louis, Mo., 315 North Seventh Street.

22 BABY CHICKS

BABY Chicks, Champion Mated, 25 varieties, 6 hybrids, licensed inspected, blood-tested. Rush postal, large colored book free, low prices. Berry's Farm, Route 11, Clarinda, Iowa.

24 DOGS, BIRDS, PETS, RABBITS

RAISE guaranteed Chinchilla rabbits. Greatest profits from gorgeous furs, delicious meat, valuable breeders. Experience unnecessary. Fascinating hobby. Year-round money-making business. Write world's largest breeder today. Willow Farm, R-18, Sellersville, Penna.

\$5,000 YEARLY possible raising Angora rabbits our Co-operative marketing plan. Iowa Angora Association, Cedar Rapids, Iowa.

\$250 MONTHLY, Raising Angora Rabbits. Particulars free. White's Rabbitry, Newark, Ohio.

GOLDEN Hamsters, money-makers, trio \$7.00. Probert, Box 315, Valdosta, Ga.

REPTILE Catalogue 10c, current bulletin 5c. Biological Hobby Catalogue 10c. Chameleon 25c. Quivira Specialties, Topeka, Kan.

RAISE Guinea pigs. Make money at home. Big demand. Booklet free. Taylor, Box 426B, Hapeville, Georgia.

SEE "Golden Hamster" ad on page 42, and "Hamster Manual" ad on page 69. Each ad shows picture of Hamster.

ANGORAS, Giant Chinchillas, white giants—World's most profitable rabbits. Finest pedigree, heavy producing, prize-winners. Literature free. Grinsteads, Edwardsville, Illinois.

25 FROG RAISING

"FROG Raising." New book teaches how. Marlborough, 1035 Marlborough, Detroit 15, Michigan.

FROGS, Crayfish, fishing canes hardwood. Lists 10c. Vol Brashears, Berryville, Arkansas.

26 FUR FARMING

KARAKUL sheep breeders for sale. Write Addis Kelly, Maywood, California.

27 MILK GOATS

RAISE Dairy Goats. All about goats and goat milk in big, illustrated monthly magazine. Sample copy 25c. Special Introductory year subscription only \$1 (regular \$2 a year). Booklet, "Primer for Goat-keepers", Free on request. Dairy Goat Journal, Dept. 868, Columbia, Mo.

30 FARMS, OTHER REAL ESTATE

FARMS, Ranches. All kinds, sizes. Choice of location, climate, production. Information on irrigation projects Columbia and Missouri River Basins. Resorts, summer homes. Milwaukee Railroad territory: Washington, Idaho, Montana, Dakotas, Wisconsin, Upper Michigan, Central Corn Belt. Free folders, price lists. L. H. Robbins, 613 Union Station, Chicago 6, Illinois.

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31 POULTRY AND SUPPLIES

RAISE turkeys the new way, write for free information explaining how to make up to \$3,000.00 in your own backyard, address National Turkey Institute, Dept. 57, Columbus, Kansas.

32 PROFITABLE OCCUPATIONS

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DETECTIVES Earn Big Money. Excellent opportunity. Detective Particulars free. Write, Wagoner, P-125 West 86th, N. Y.

EXTRA money? Free Details. Trable, 1018 $\frac{1}{2}$ Elm Street, Dallas, Texas

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RAISE Rabbits. Easy to start. Very profitable. We teach you details free. Harder Farms, Rt. 1, Box 186, Campbell, Calif.

START lamp factory. Profitable, fascinating, easy to learn. Illustrated course teaches you. General instructions, wholesale catalog \$1.00. Gearon Company, 6405H North Oakley, Chicago.

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INSTRUCTIONS how to make Rubber stamps — luminous paints — money from sawdust — resilver mirrors — raise earthworms. 25c each, all for \$1.00. Davies, Box 1087-PS, Kingston, Pa.

COMPLETE flock finishing outfit. Spray gun, adhesive, two colors flock, brush, instructions—\$7.50. Parvin Manufacturing Co., 1155 So. San Pedro, Los Angeles 15, California.

MAKE beautiful mirrors from ordinary window glass. No expensive equipment required. Details free. Tesco, Box 189-SE, Wilkes-Barre, Pa.

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900% PROFIT. Stamping key-protectors, dog-tags. Arrington's, LaGrange 15, Georgia.

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MAGICIANS' Gamblers' secrets exposed. Cards, Dice, Punchboards, Slot Machine. Catalog 10c. Book Co., Box 871, St. Louis 1, Mo.

WORLD'S largest professional magic shop, keeps you in touch with latest tricks. To receive mailings, send 35c for new catalog. Holden's, 220-P West 42nd St., N. Y.

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BE the Life of the party! Wear Electric bow tie. Complete, tie, bulbs, battery all for only \$1.50! No C.O.D.'s. Electric Bow Tie Co., 306 Bowery, New York 12, N. Y.

37 COIN COLLECTING

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VALUABLE information. U.S. coins from 1652 to present, prices paid by collectors. 254 page book; prices paid by dealers. 48 page book; both handsomely illustrated—the two for \$2.00 (send money order—not stamps). Hobby Helpers, Dept. G2, Box 665, Washington 4, D. C.

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COLORGLAZED Concrete Pottery made without molds. Patented method. Cemetery products, novelties, tiles. Basement leak-sealing. Money-making projects. Booklet, details free. Men only. National Potteries, Grand Rapids, Minn.

YOUR own plastic business at home. Produce costume jewelry, novelties, statuettes, liquid plastic, liquid marble, flexible molds. Write for free book. American Trades, Box 89-B-5. Cincinnati 39. Ohio.

MEN and women wanted to place self-selling coin machines in stores, hotels, filling stations, etc. New machine earns up to \$6.00 weekly—costs only \$10.50. We furnish supplies and machines for nuts, gum, candy, stamps, scales and amusements. Free details of tested selling plan. Write Dept. Z, Parkway Machine Corp., 623 W. North Ave., Baltimore 17, Md.

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OPERATE profitable mail order business. Write Walter Service, 4159-B East 112th, Cleveland 5. Ohio.

TYPISTS. Profitable business at home. Complete copyrighted information, 50c. Gaunt, 3521-G Broadway, Chicago 13. Ill.

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BE A used car dealer. Tested plan \$1.00 or details. Smith, 17E Rockland Ave., Yonkers, New York.

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SPECIAL Rubber for making molds. Literature and sample free. Universal, Box 1076-B, Peoria, Ill.

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HOMEWORK: Addressing envelopes. Details 25c. Siegel, 126 Lexington, N. Y. 16.

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UNBELIEVABLE but true! I am a Preacher, nevertheless made over \$2300 in 30 days, honestly, legitimately. You may do as well. Details \$1.00. F. J. Winder, 4638 N. E. 34th, Portland 11, Oregon.

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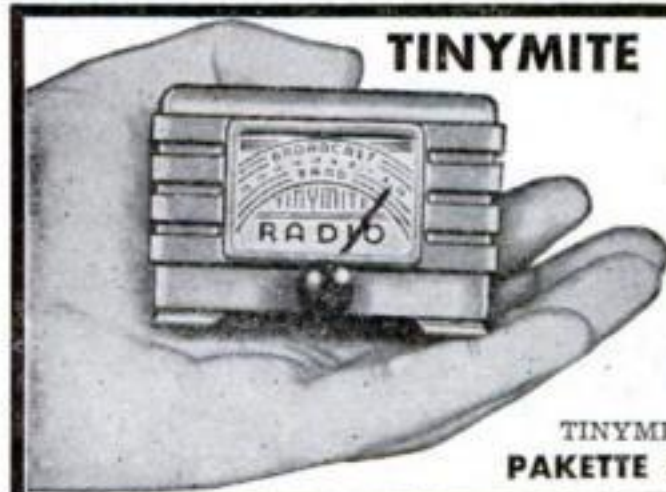
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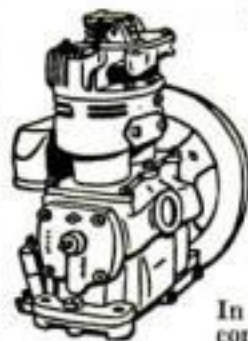
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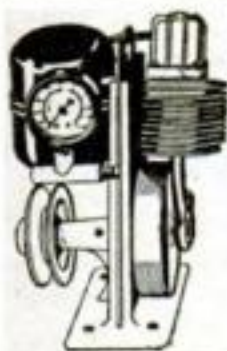
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● Yes, your modern power tools are marvels of speed and accuracy IF — and it's a big *if* — *you* are accurate in their use, if *you* make them do their best work. And that's where your flashlight comes in handy. Better keep it powered with "Eveready" batteries. Powerful, dependable, *they outlast all other brands.**



← Gauges for power tools are frequently in shadow where they are hard to read. That's where you need your flashlight to make adjustments with a fine degree of accuracy.



A clamp on the side of the table → will keep your "Eveready" flashlight handy, ready for use.



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*According to the "General-Purpose 4-Ohm Intermittent Test" devised by the American Standards Association, which most closely approximates average use.

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Proof! . . . in the laboratory . . . in your own flashlight . . .

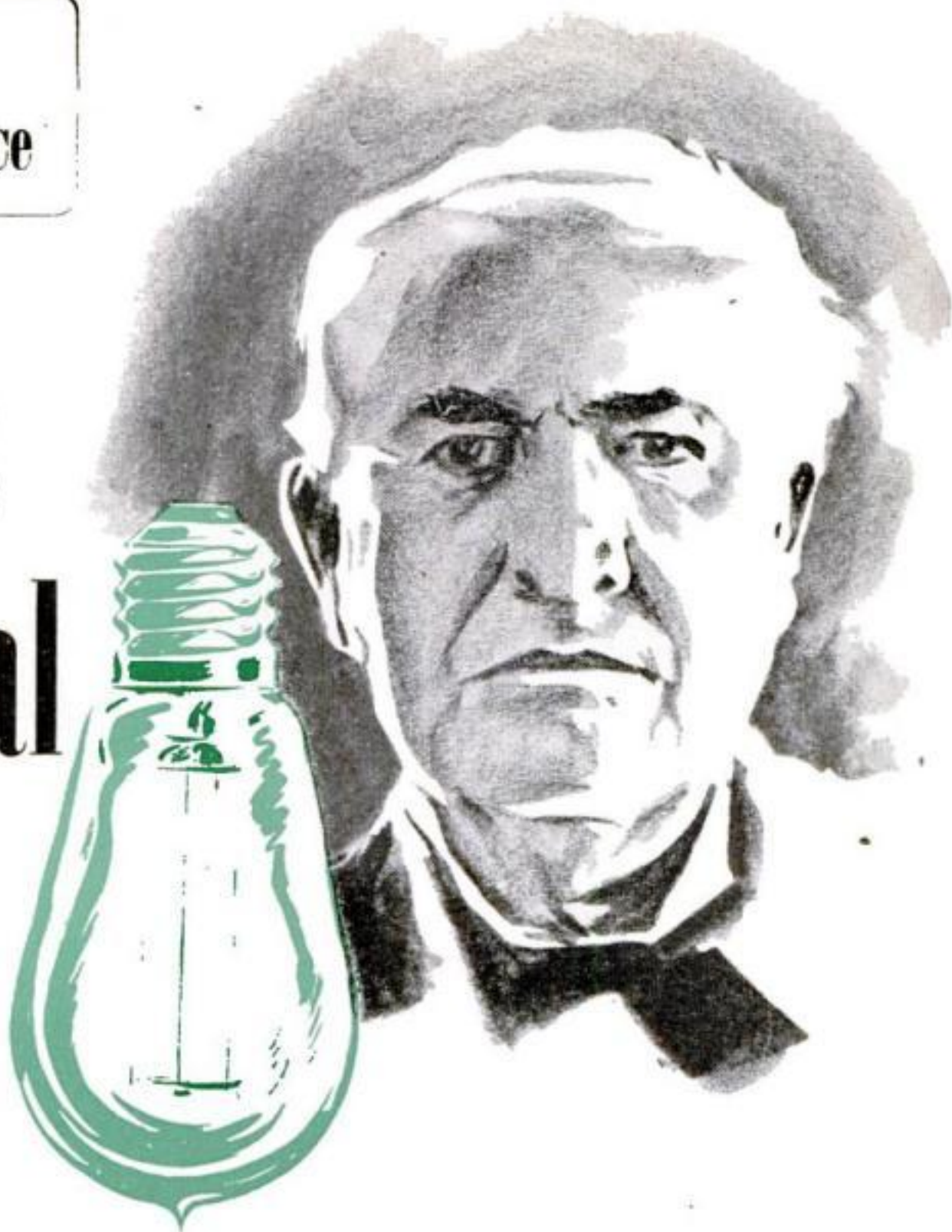
"EVEREADY" BATTERIES

OUTLAST ALL OTHER BRANDS!*

PS

The Voice of Science

Edison's Practical Science



YEARS ago there was a story around about Thomas Edison. This fable illustrates an argument that is still going on. It's the kind of story that ought to be repeated annually anyway.

It seems Edison was interviewing a bright young man who considered himself something of a science hot-shot. He had a head full of figures, some of which were facts. His tool kit bulged with slide rules, calipers, micrometers and the like.

Edison is supposed to have handed the Bright Young Man a then-everyday light bulb, the old kind with the tip. Measure the cubic contents, he told the B.Y.M.

The B.Y.M. calipered the truncated cones and hemisphere of the bulb. Then he broke the glass carefully, and miked the fine wires and their glass support. He dived into solid geometry and came up with an answer carried out well to the east of the decimal point. That, he thought, certainly should

convince Edison—if the old man could follow such complex calculations.

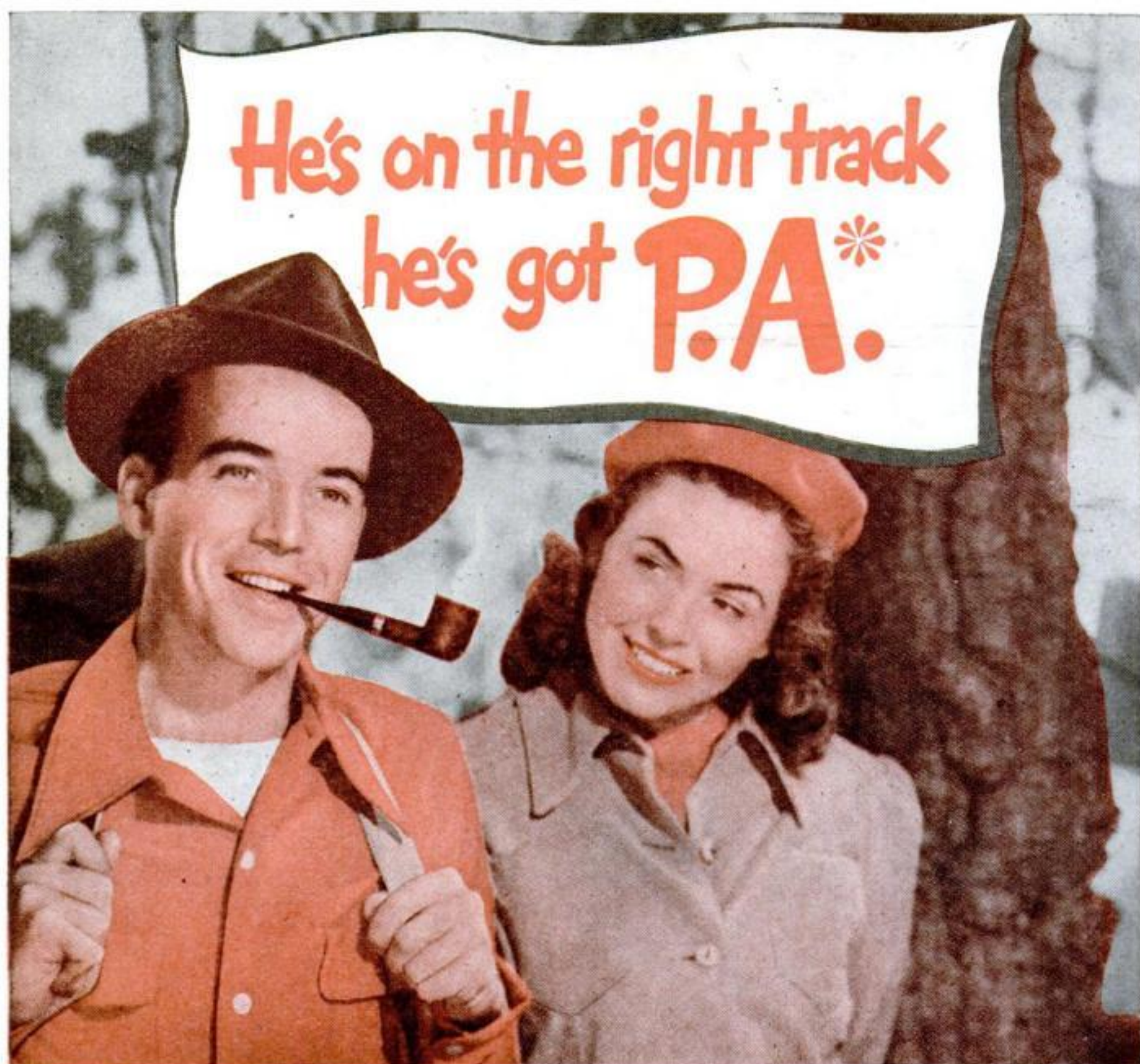
Proudly he returned to Edison and presented the figures. The old man rolled out his lower lip and nodded. Pretty close, let's see how close.

Edison reached into the nearest fixture for another bulb. He filled a glass graduate with water. Then he immersed the tip of the bulb in the water, carefully broke it off with pliers. The water rushed in to fill the vacuum. Edison took a reading on the graduate. Then he proved it out by releasing the water in the bulb into another graduate. The B.Y.M., remembering his hours of measuring and calculating, sighed and grinned.

The moral of this fable is that the obvious, or practical, approach is all the more scientific if it's quicker.

Perry Githens

APRIL 1948 95



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P.A.* means **Pipe Appeal**

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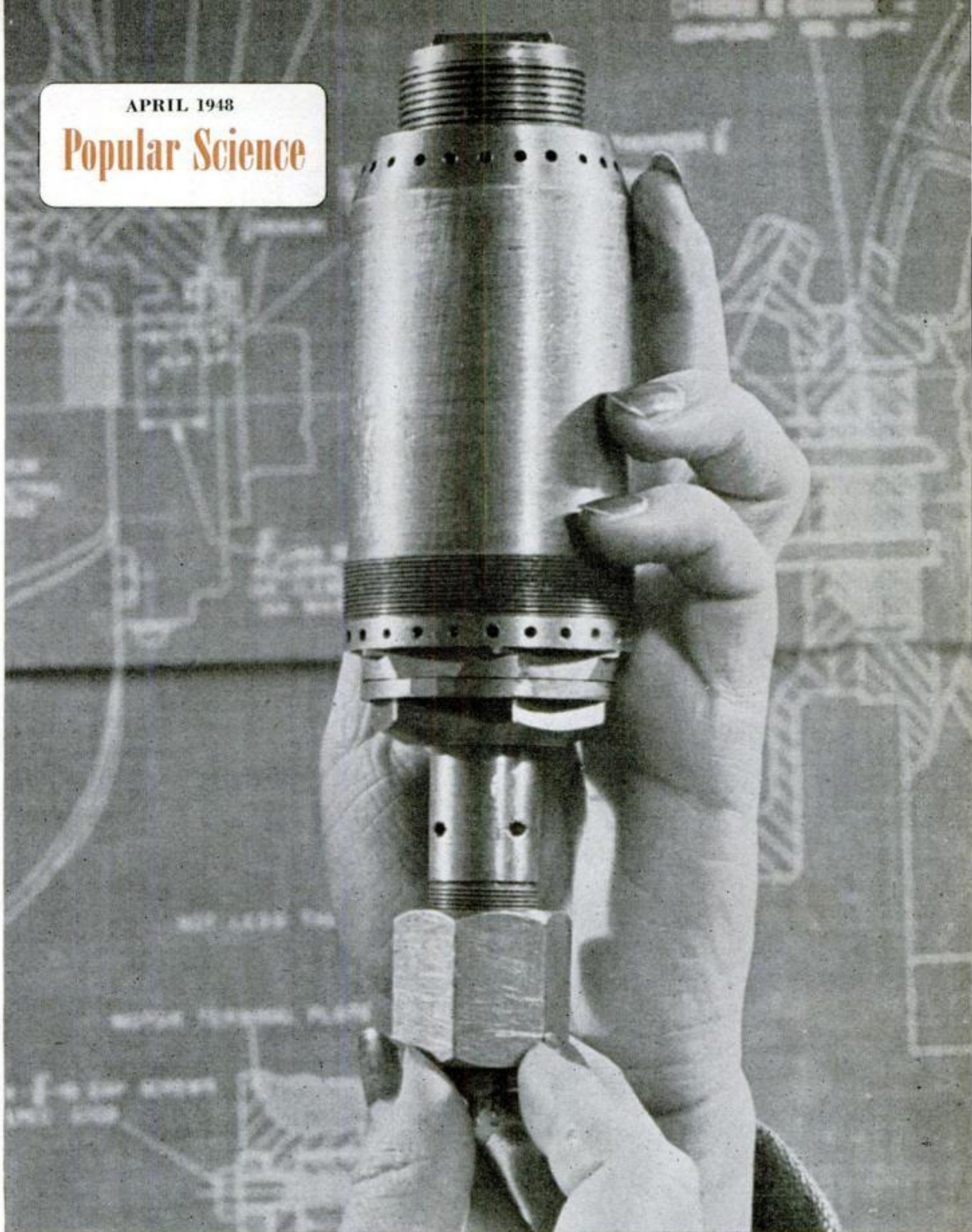
The National Joy Smoke

R. J. Reynolds Tobacco Co.
Winston-Salem, N. C.

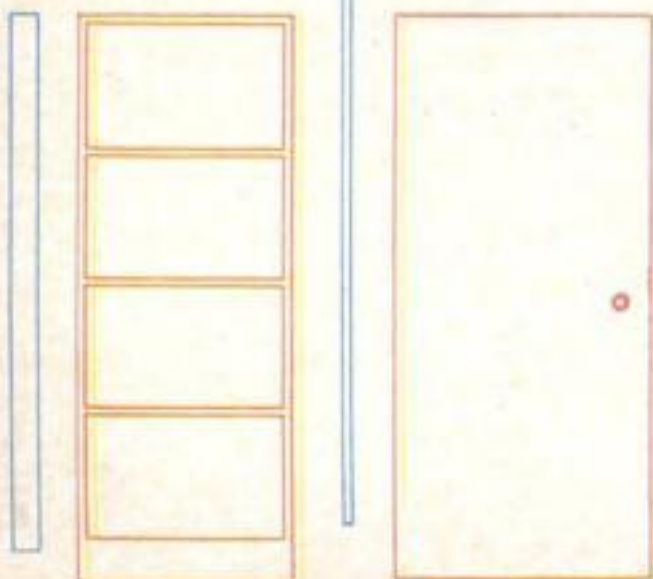
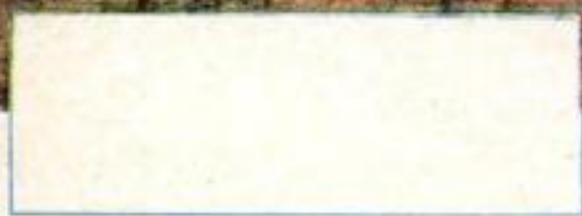


APRIL 1948

Popular Science



80,000 r.p.m. Inside Out... This pocket-sized, 1/10-hp. electric motor not only works up a dizzy 80,000 r.p.m., but it does it "inside out." Unlike conventional motors, its outer shell revolves, while its core remains stationary. Built by GE for the Army Ordnance Proving Ground at Aberdeen, Md., the mighty midget puts the spin on high-velocity projectiles undergoing wind-tunnel tests to determine their behavior at supersonic speeds. Fastened to the inside of the projectiles, it simulates their whirl in actual flight.



Without a single nail in the walls, a bookcase with a door hinged to it blocks up the familiar arch (inset) between living and dining rooms. Basic items, sketched at left, are bookcase and door; trim board, molding, and topping board dress up the job. A lintel board on top of the bookcase will carry a doorstop and latch if you want it. Since bookcase provides support for the entire structure, it must have fairly substantial sides and shelves, but the back can be of the thinnest wallboard. The door need only be strong enough to resist warping and sagging. If the unit is to be temporary, pin-type hinges will simplify dismantling.

**Whether you rent or own,
whether you can drive a nail or not,
here are ideas to enlarge your living
without enlarging house or budget.**



10 Easy Ways to Get "that Extra Room"

By John F. Stearns

With the Editors of Popular Science

JOSEPH ARONSON, *Architectural Consultant*

PS Staff Photos

Drawings by Sigman-Ward

HAVE you a little housing shortage in your home? Has a new baby taken over the "master" bedroom? Have two kids growing up where one grew before turned shared space into a battlefield? Is there an in-law waiting out the bridge game to make camp in the living room?

Most families have some such problem. But few realize that something can be done about it without risking the wrath of the landlord. Or that you can add living space to your own home without building an addition on the house.

The Practical Touch

To explore the possibilities, POPULAR SCIENCE called in Joseph Aronson, an architect who has specialized in interiors. In his professional work, Joe Aronson has faced all the typical problems in fitting people into places.

And he has come up with practical, workable solutions ranging from a simple, but solid and stable, screen to a ceiling-high storage wall. He says, "the hardest part of any problem is to get people to break with

habit and tradition—and accept the obvious answer."

For example? Well, here's a dining room idle 22 hours a day. There's a kitchen big enough to dance in. Here's a sunroom that is shut off when the leaves fall, simply because it's like Macy's window. There's a living room that could be a fine one-room apartment.

All that is needed in most cases to create living space out of empty air is a wall. If most people shudder at the thought, it's because they think a wall is a minor Boulder Dam, expensively and irrevocably constructed of cement or plaster.

A Wall Is What You Make It

Actually, a wall need only be a partition fitted to a purpose. Like Lincoln's legs, which were just long enough to reach from the hips to the ground, a partition has only to be high enough to cover the problem.

Modern materials permit a small solution for a small problem. Take the Case of the Quarreling Kids, where a difference in sex or even a slight difference in age makes a big difference in bedtime or living patterns. The quickest, cheapest solution calls only for a chunk of wallboard. Simply swing the beds head-to-head with the wallboard held between them. Buy as big a piece as you can get into the room. Bolt the head-

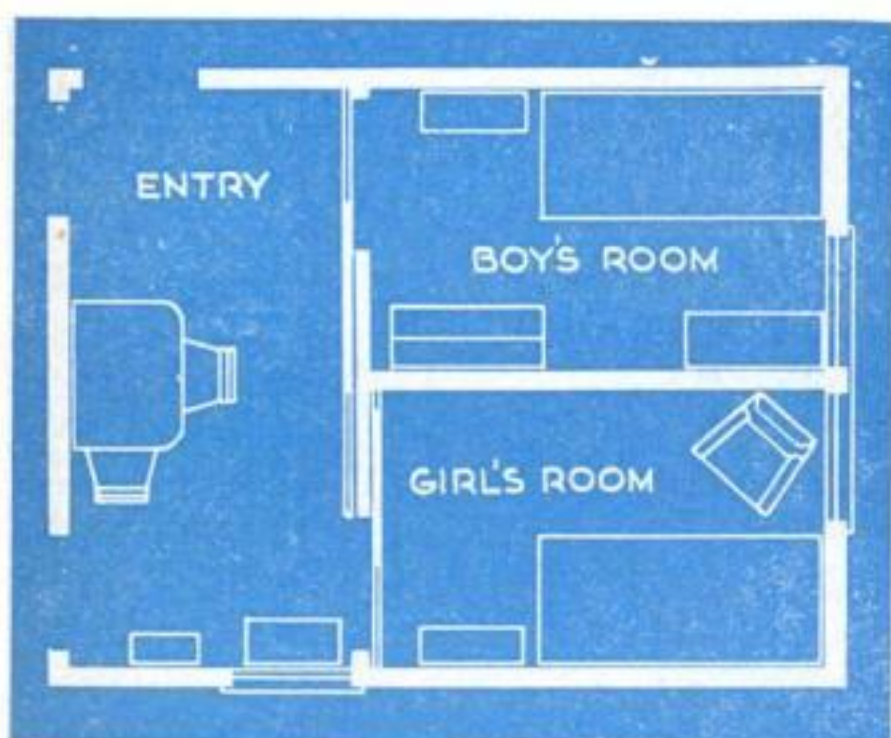
boards together through the wallboard if you have boys.

Another cheap-and-easy answer to many problems is the king-size screen, a solid citizen compared to the familiar folding screen, which is a shaky and temperamental affair.

The solid Z-screen is one of Aronson's proudest products of obvious thinking. It consists of two stock flush doors, costing

about eleven bucks each, attached at right angles to a panel of wallboard. The doors are light veneer on a honeycomb base, and are used as sold—without hardware. The wallboard is the structurally strong, not the plaster, type.

Such a screen has enough stability to make a practicable partition. A casual bump from a passing shoulder isn't going to knock it over on the new baby or the



Floor plan of a three-room suite for a brother and sister shows what one family did with a single room, about 12 by 15 feet. Dividing wall is of composition board, braced with 1-by 3-inch planks fastened to floor and ceiling. Sliding doors, moving in tracks made of wood strips, give complete privacy in the two bedrooms. For a less expensive project, doors could be omitted or replaced by curtains.



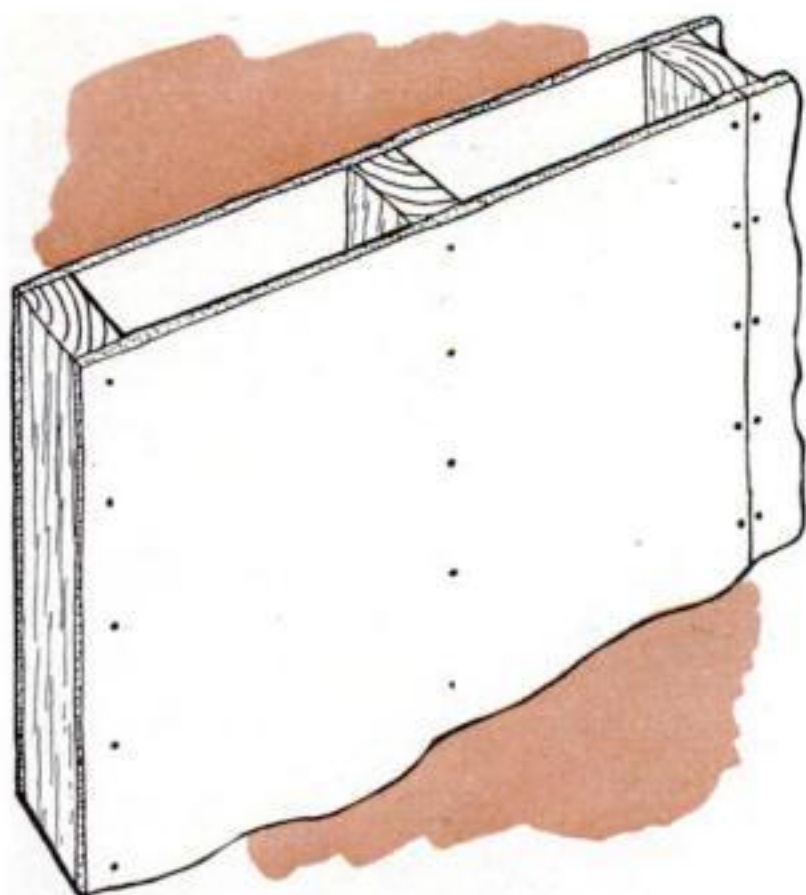
Entry, providing playroom and study space, holds game table, bookcases, and bureaus for out-of-season clothing. Track of sliding door is at lower left, forming sill of girl's door.



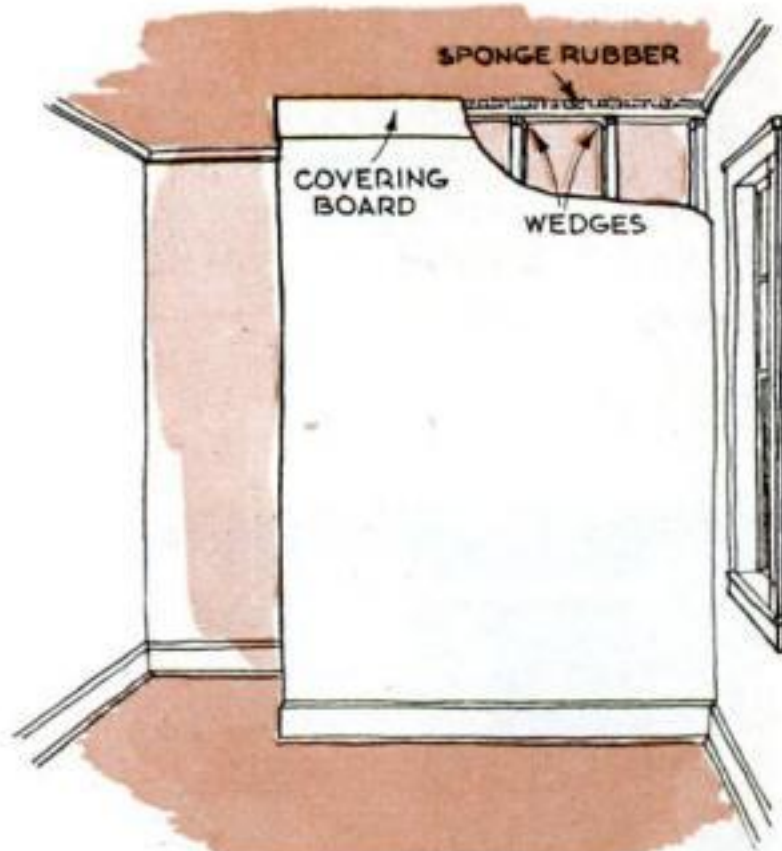
Boy's room, seen from the entry, shows compact arrangement. Panels and braces were left unfinished on this side, since dark panels and natural-wood braces make a good color scheme.



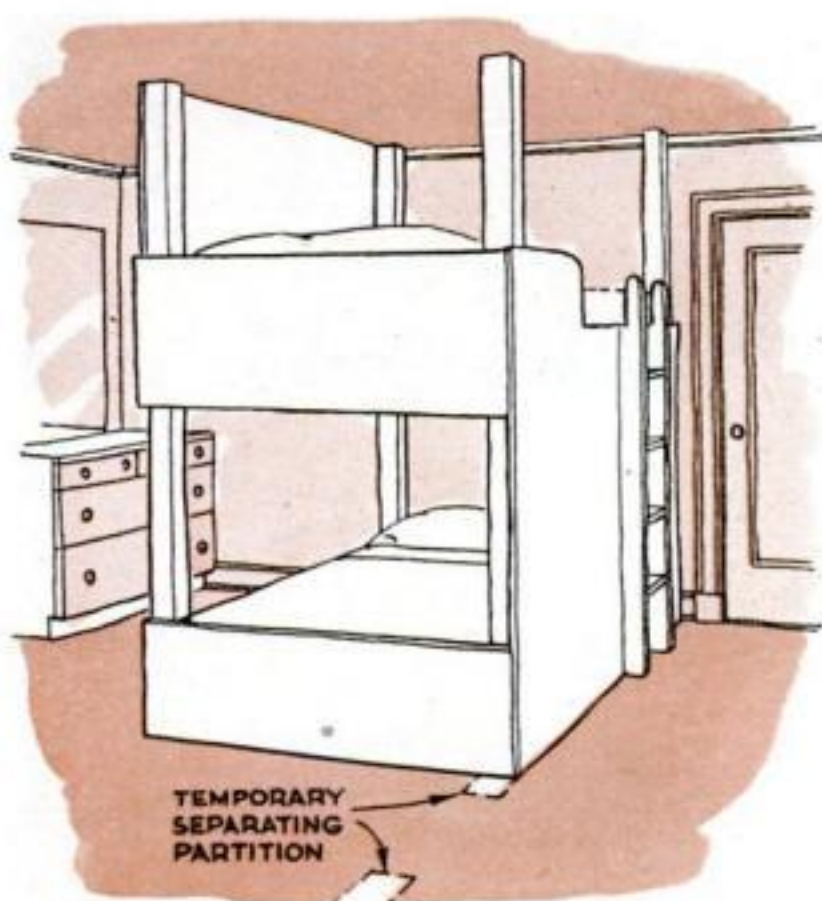
Girl's room has wallpaper over the panel, but otherwise is the same. Floor and ceiling fastenings, necessary in this construction, can be avoided with variations shown on next page.



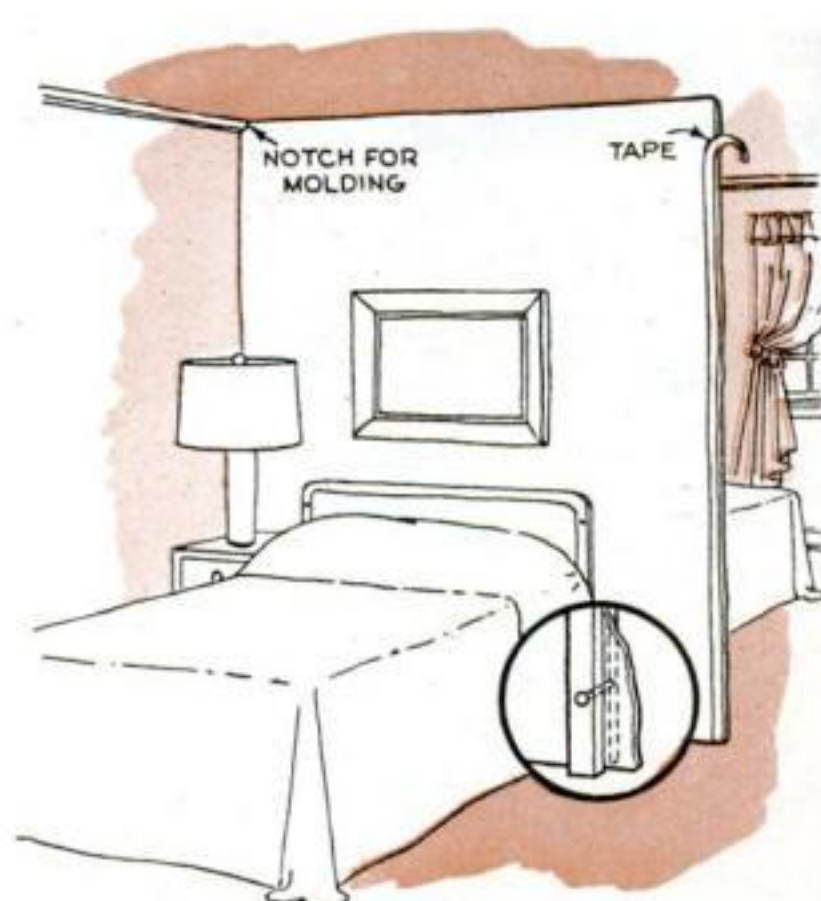
Double-panel wall, made by nailing any light sheathing or wallboard on 2- by 4-inch uprights, can be put up with expansion joint. Uprights are cut just short of ceiling height. With a plank



laid above them and topped with foam rubber or fiber insulation to protect ceiling, wedges driven between uprights and plank will lock wall in place. Covering board adds support.



Double bunks make a wall, too, with plywood enclosing one side of top bunk and opposite side of bottom bunk. With ends covered, a door hinged to upright will complete the division.



Two beds, head to head, support a partition between them. Beds can be bolted together for solidity, but panel itself should be fairly substantial. Decorator's tape finishes edges.

Tips on Wall Materials

A list of wallboards by properties and trade names fills a book, but here are four basic categories (Standard panels are 4' x 8'; larger sizes are often available):

Plywoods—Most versatile, but at present hard to get; $\frac{1}{4}$ " to 1 $\frac{1}{2}$ " thick; high structural strength; wide variety of surfaces.

Plasterboards—Generally gypsum base, paper faced; various thicknesses; low structural strength; require bracing.

Hardboards—Fiber or asbestos composition; various thicknesses and surfaces; strong, but often need bracing.

Softboards—Insulation board and sheathing; often rough-surfaced; various thicknesses and strengths; need bracing.

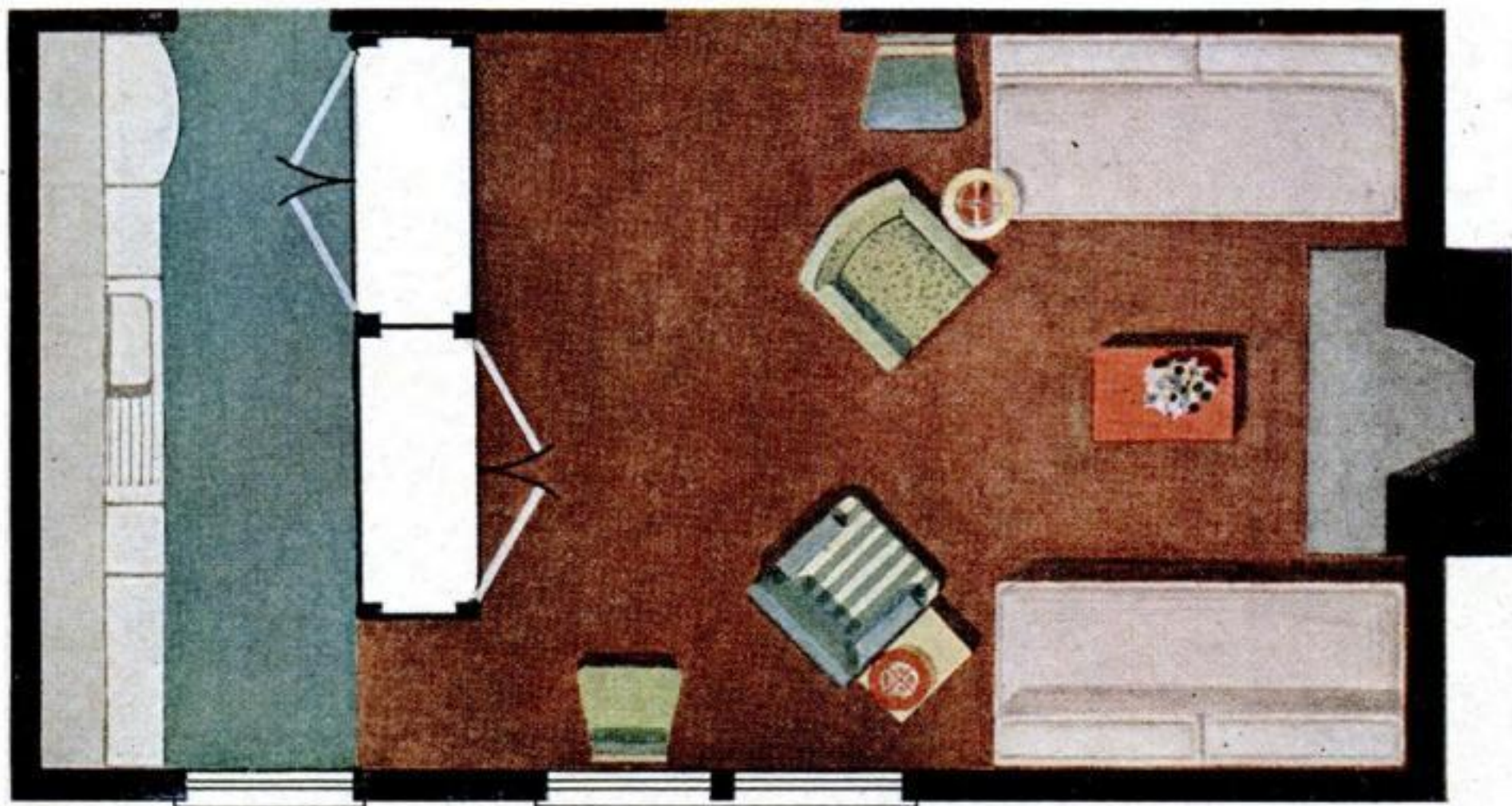
new wife slaving over the new two-burner stove. And it's high enough (a standard flush door is 6 feet 8 inches tall) to provide visual privacy.

Slant a Z-screen across the sink end of the big kitchen, common in old houses, add a lamp and table, a couple of chairs, a few colorful pictures and accessories, and you have acquired a cozy living room. Put the baby behind a Z-screen in the corner of the

bedroom and you'll dare to read in bed again—if you're quiet about it.

These suggestions are all expedients. More money, and more imagination, will permit more permanent solutions. But even the most solid of the partitions presented here can be built without so much as a tack puncturing the landlord's precious woodwork or temper.

Take the gaping arch between the typical

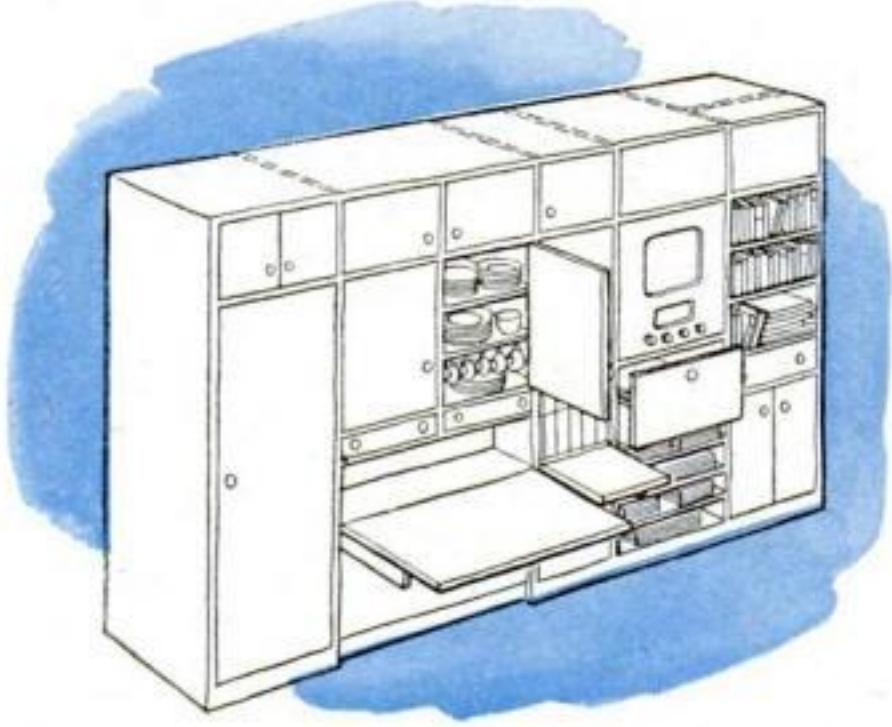


Put two closets together and you have a storage wall like the one providing a separate kitchen for this one-room apartment. Closets can be built as a single unit if the desired dimensions permit, or can be made separately for easy handling. Don't make them too big; their diagonal measurement must be less than ceiling

height or you can't tip them into place. If you want a full-height wall, topping boards that reach the ceiling can be fastened to closets once they are in place. If closets are to have shelves, be sure framework is sturdy enough to support the added weight. Strength of paneling helps here by supplementing that of the frame.



Storage-wall variations are legion. Here are a wardrobe and cabinet, standard furniture items. Add a top panel, center panel and dressing-table shelf—and there's your complete wall.



Sectionalized units permit such dressed-up versions as this, with closet space, a folding desk-table, room for a television set. Shelves for dishes can have doors on both sides of wall.

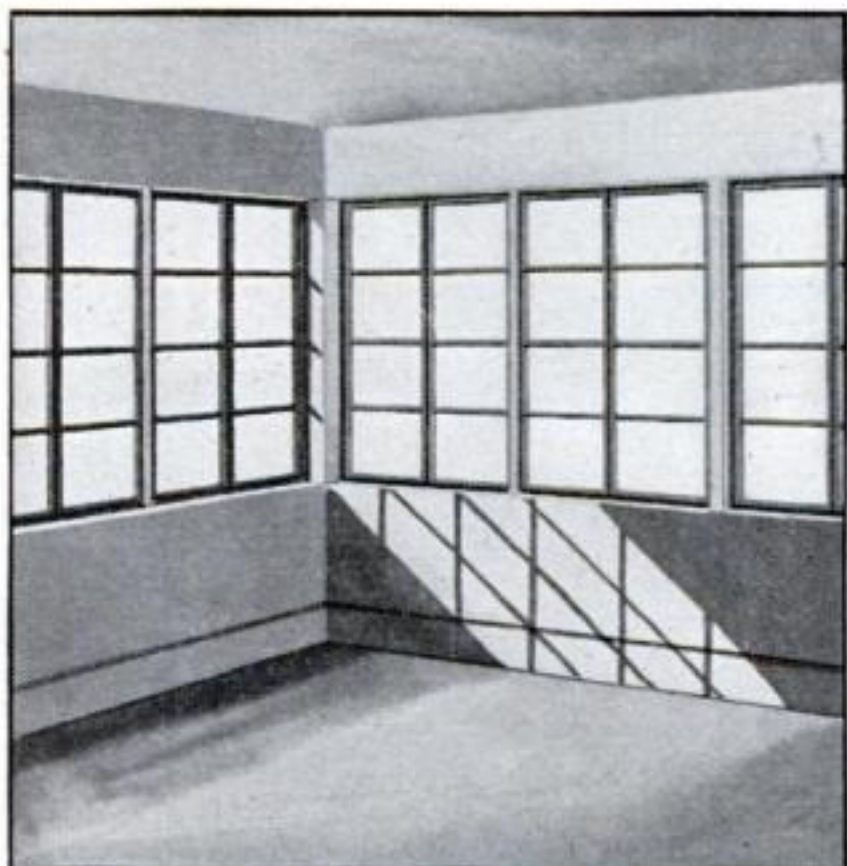
living room and dining room. A bookcase with a light door *hung on the bookcase* is all you need. The weight of the books provides the necessary stability.

The bookcase needn't even fit if false boards are used. And the result can look like one of a decorator's better dreams, as the pictures show.

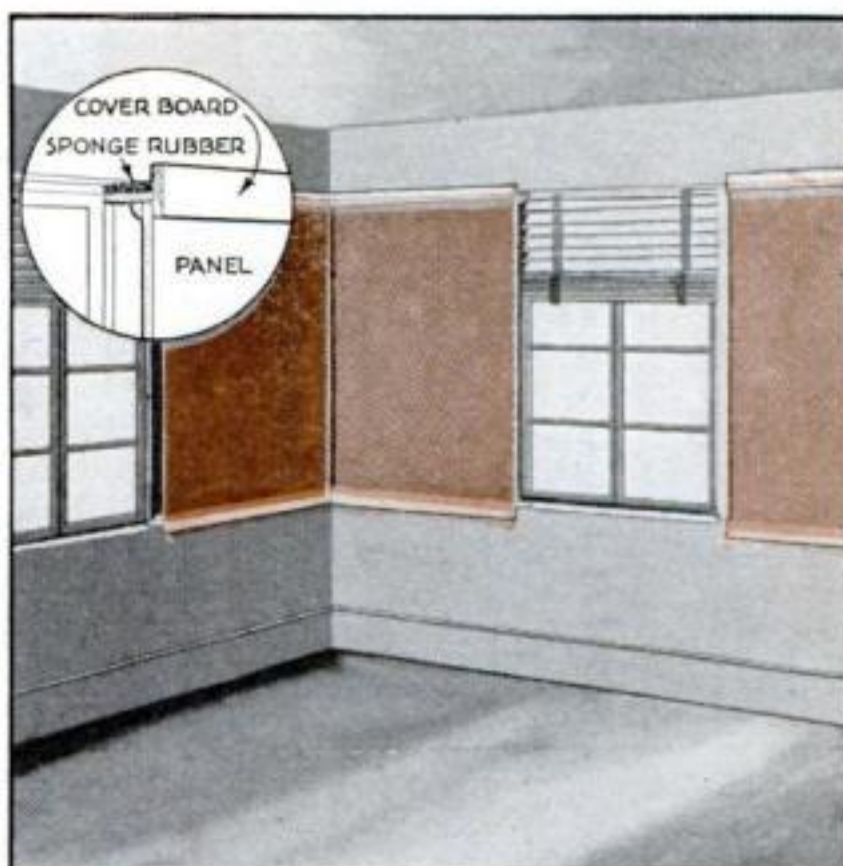
If you know how, you can even have a full-height, extra-thick interior wall without

a scratch on the ceiling or the floor. Such a self-sustaining partition can provide closet space, plus more complete privacy than most original walls. This is the answer for the long-term doubled-up family, or for the people who would like the income from a completely separate one-room apartment.

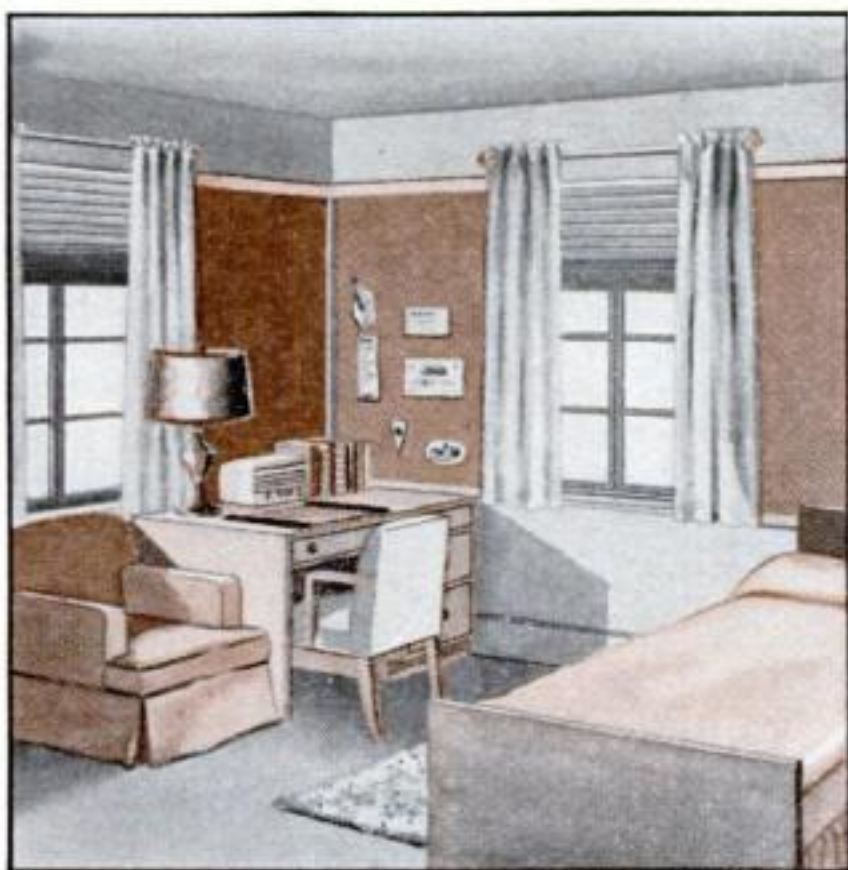
In this article, we cannot give you blueprints or architectural specifications, but we can supply you with ideas to start you think-



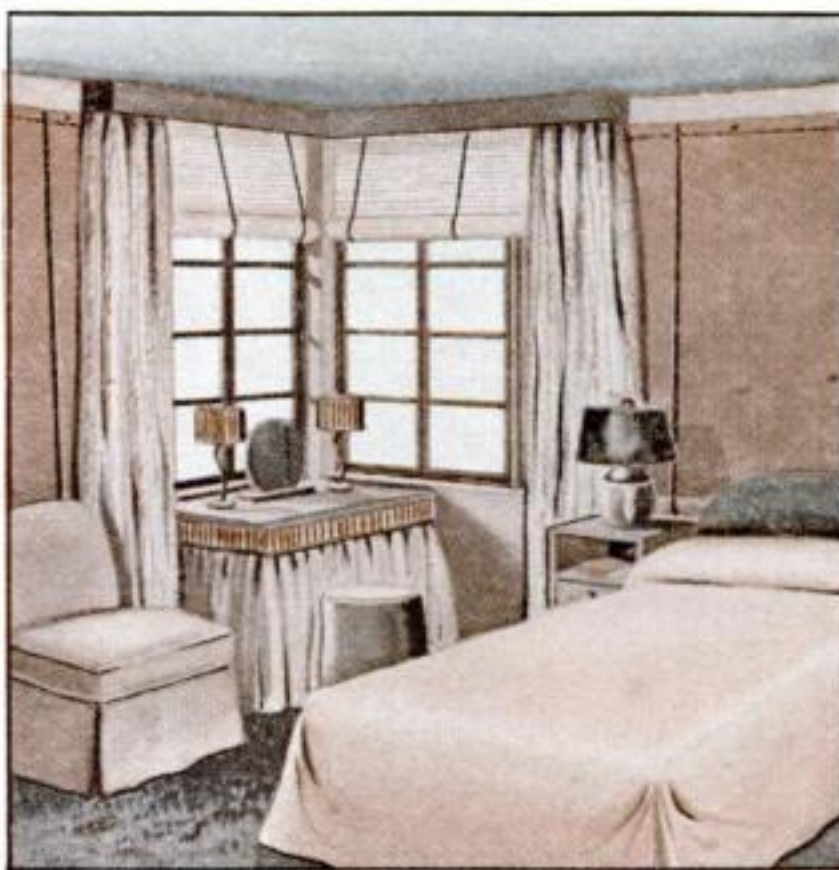
The sun room and the glassed-in porch are worth more than just summer-time use these days. Here are two methods of blocking off unneeded windows to make any kind of room.



Padded cleats, top and bottom, hold light-weight panels over unwanted windows by pressure of padding, which is squeezed into place. Venetian blinds are put over remaining windows.



With drapes and furnishings, the sun porch becomes a brand new room. Pressure mounting makes panels easy to install or remove and permits variation in arrangement of room's windows.

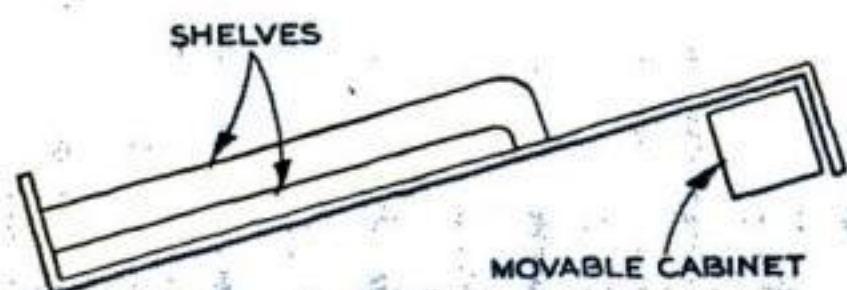


Second method is even simpler. Snaps hold roller shades over unused windows, and slatted porch shades replace the venetian blinds. This version can be reconverted in a hurry.

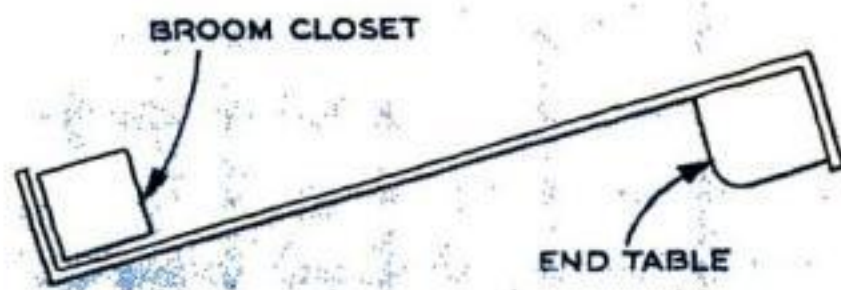


Transforming excess kitchen space into a living room is only one of many jobs for the Z-shaped screen, a wall supported by its own right angles. This one, 6½ feet high, is made of two 4-foot-wide panels of ¾-inch plywood and two

flush-type, mahogany-veneer doors. Any strong, rigid paneling can be used instead of plywood and doors. Here, all four parts of the screen are hinged, but angle braces and cleats make sturdy, fixed joints if they are desired.



Shelves fastened to kitchen side add strength and convenience; cabinet also helps brace wall.



Switching sides, corner shelf serves as a living-room end table; kitchen gets broom closet.

ing like a professional about your own problem and the possibilities that are usually present.

If you are a regular reader of the Mechanics and Handicrafts section of POPULAR SCIENCE, you will have no trouble adapting some of these ideas to your special situation.

But even if the thought of a hammer makes your thumb sore, you can do plenty about your problem.

The first thing to do is to put on your hat, go outdoors, and come back in as if you had never seen the place before. Leave your hat on, just to remind yourself to for-



Set up in parents' bedroom. Z-screen creates a miniature bedroom for the baby. For added sound absorption, nursery side can be padded with rock-wool insulation or quilting batts, then

covered with cloth or oilcloth. Staples or upholstery tacks, driven through covering and padding in regular rows, produce a quilted effect; tape makes a neat finished edge.



Bedroom side shows how well the screen cuts off the nursery. Screen need not be set against a wall; it can be angled to isolate a corner, or, if joints are hinged, its panels can be set to take

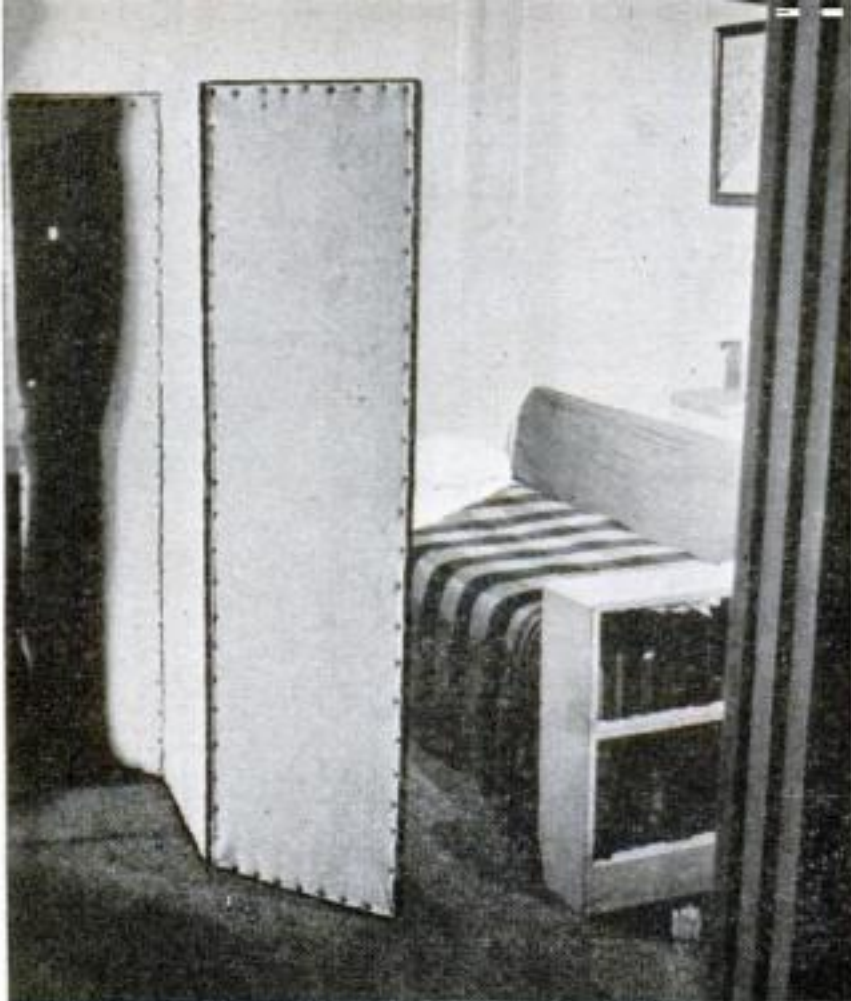
advantage of any floor plan. The screen is inherently stable enough for most needs, but it can be braced with a bookcase or bureau to provide an additional safeguard.

get old habits and family traditions. Next, sit down with an old envelope and a dull pencil and define your problem.

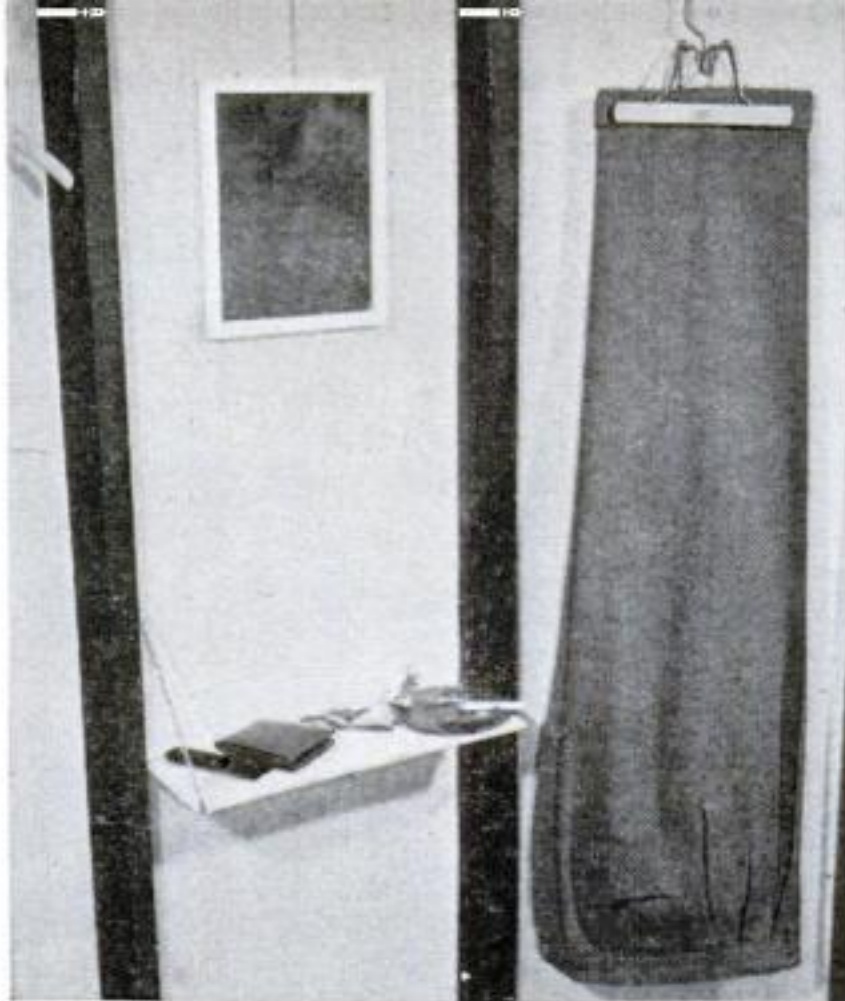
You will find that it breaks into two parts:

1. What kind of extra room do you need?
2. Where can you steal empty air for living space?

One elderly couple I know, in nagging need of an extra bedroom, found that three-quarters of their space was taken up by a big kitchen, a big dining room, and a living room the full width of the house. Closing the usual archway made the dining room into a bigger than average bedroom. Now,



Shaky though it may be, the common accordion-type folding screen has shielded thousands of overnight guests, is handy for emergencies.



Clothes hooks, mirror, and folding shelf give the guest a break. Shelf can be triangular, fitting between open panels to brace screen.

they eat in the kitchen and like it. An electric ventilator in the window, and a seven-foot Z-screen concealing sink and stove, have made the kitchen the most livable room in the house.

Your problem may be tougher. At first

look, rooms may seem too small, too cluttered. But try visualizing them without furniture, without prejudice of their previous use, as they were when you first moved in. What you see may surprise you—and give you “that extra room.”

END



Any solid piece of furniture supports a light panel, and any light panel can be braced to make a firm wall. Half-round or square mold-

ing as a supporting lattice on one or both sides forms a decorative pattern and helps hold nails or screws that fasten panel to furniture.

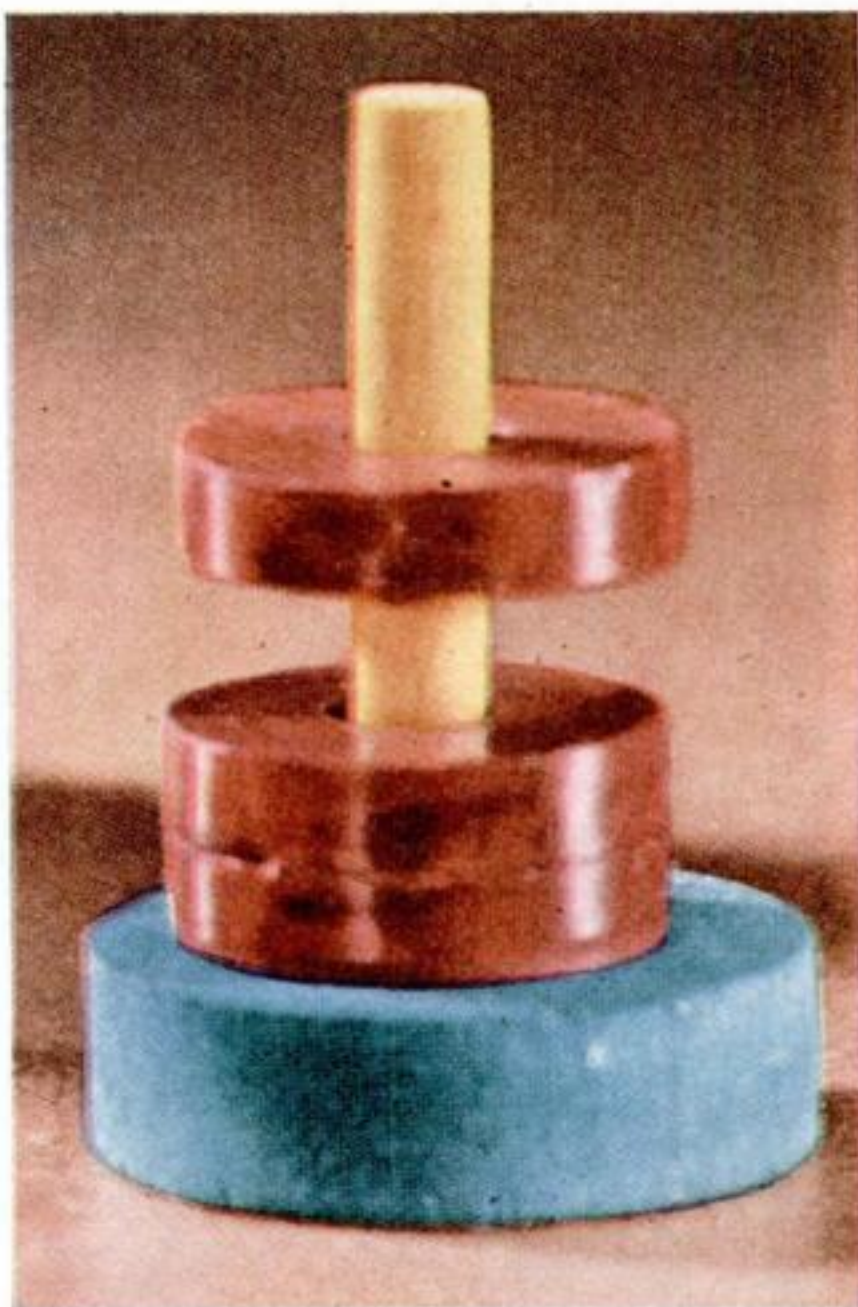
Plastic Magnets Do Tricks

THE odd behavior of the little rings pictured on this page is easily explained. They float in the air and perch at queer angles because they are magnets; each one attracts or repels the others, depending on whether like or unlike poles adjoin.

There the real oddity begins: the rings are not metal, but plastic—permanent plastic magnets that weigh half as much as iron, don't conduct electricity, cost a fraction as much as metal magnets, and maintain their magnetic properties just as long.

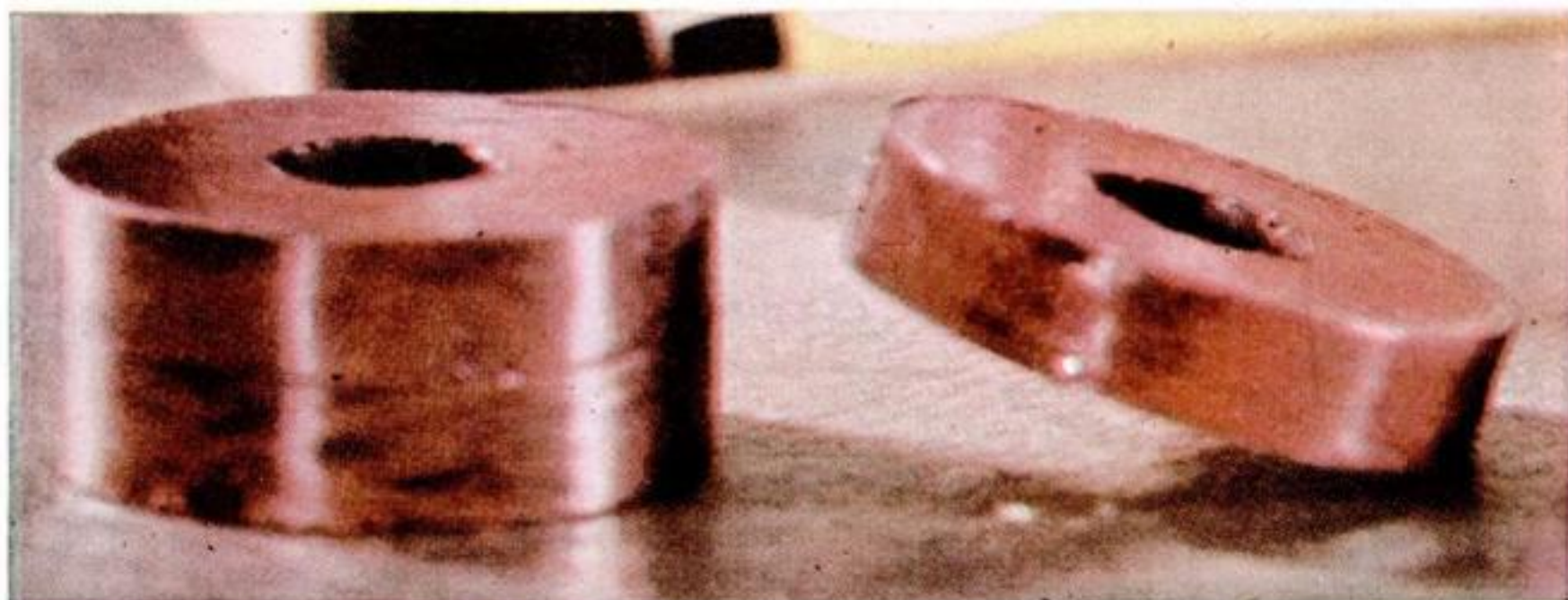
Called "Dizzy Discs"® by the Norton Trading Co., of New York, which markets them, the toy rings (and other toys to follow) represent only a small phase of a rapidly developing field. Because of their lightness and electrical properties (they act as capacitors, holding but not conducting electric charges), magnetic plastics may replace metal in many electronic devices—loudspeakers, magnetic recorders, lightweight meters and motors for aircraft. Britain already uses them in telephones.

The Norton Co. is reluctant to say just how its magnets are made, but the idea of nonmetallic magnets is an old one. Many materials—even beeswax—can be made magnetic by melting them and allowing them to harden under a strong electric charge. The charge aligns atoms in a neat north-



Upper and lower faces are rings' north and south poles. Here unlike poles of bottom two attract each other while top ring, repelled, floats in air. Wooden stand comes with the rings.

and-south polarity, and they stay aligned after the material hardens. (The Plastics Research Co., of Alhambra, Calif., which makes plastic magnets this way, calls them "Electrets."®) Another method is to mix certain ferrites (oxides that can be magnetic without being metallic) in a plastic base.



Balancing act is only one of many tricks; the three-quarter-inch rings even turn somersaults.

Other proposed toys are plastic-magnet trains and thimble-size, 1/1,000-hp. electric motors.

Oil By-Products Battle Bugs

BY COMBINING new chemicals with new techniques of application, agricultural experts are winning the battle of the bugs on a 142-acre experimental farm near Modesto, Calif. There, under the direction of the Shell Oil Co., they are injecting Mother Earth with more than 400 petroleum-produced insecticides and fertilizers in an all-out fight against crop-destroying insects.

In one of the new techniques, known as the dry method, the chemicals are literally plowed into the soil. In another, the wet method, they are piped into irrigation water. In addition, crops are showered with clouds of dust insecticide from both ground

and air. With these means, the experts are also battling toxic soil, tree decline, wilts, rots, smuts, cankers, and molds.

One chemical, called D-D, has proved particularly deadly to insects. Produced by fractionating natural gas, it rid Hawaii's pineapple fields of the nematode, which had cost growers there millions of dollars.

Like a woman's work, however, the job of the pest fighters is never done. In time, insects develop immunities to certain chemicals, and new poisons must be found. This and the constant invasions of new insects are keeping the pest experts on the jump to stay ahead of the plant-eating hordes.

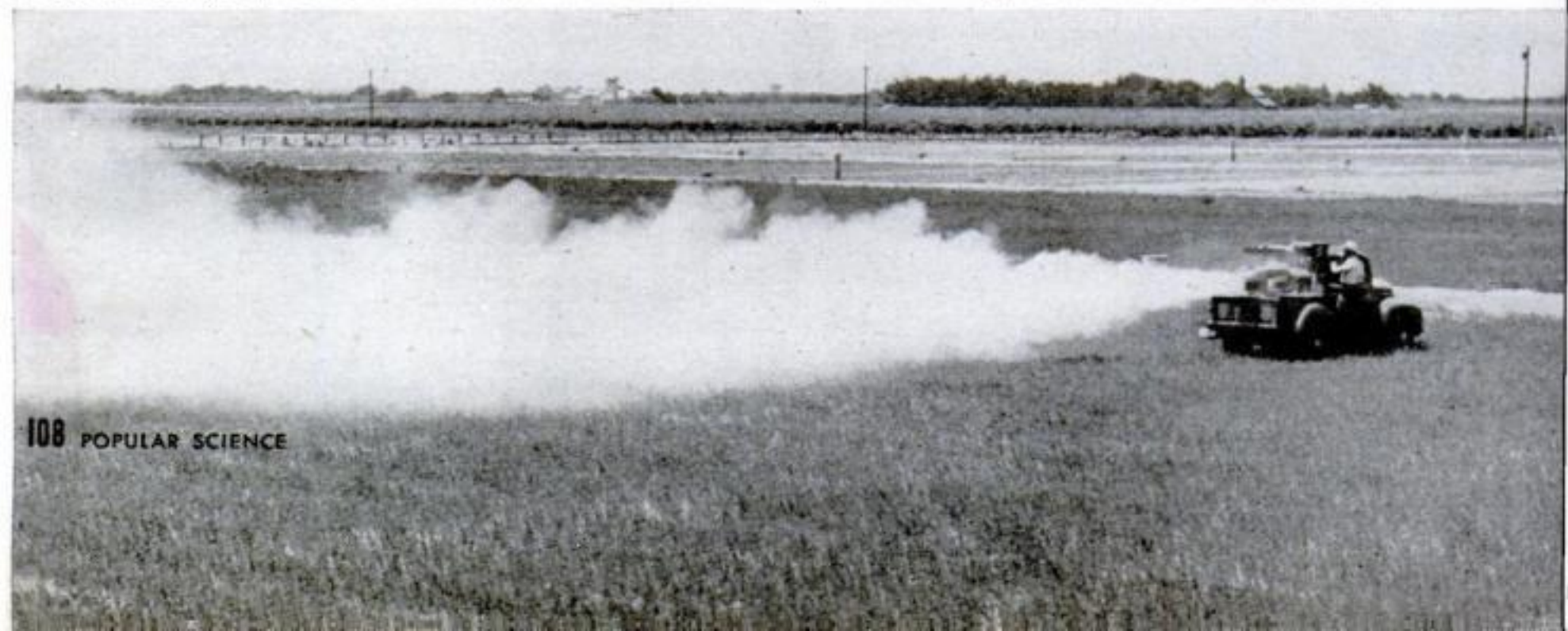


Dry method: Ammonia and D-D are piped directly into the soil. Tubes behind the blades of this tractor-drawn harrow direct the chemicals into the ground eight inches below the surface.



Wet method: Ammonia, which supplies life-giving nitrogen, is piped into the crop irrigation system. Absorbed by the water, it is carried down to the roots of the growing plants.

Not a tank laying a smoke screen, this mechanized crop duster wages a different kind of war.





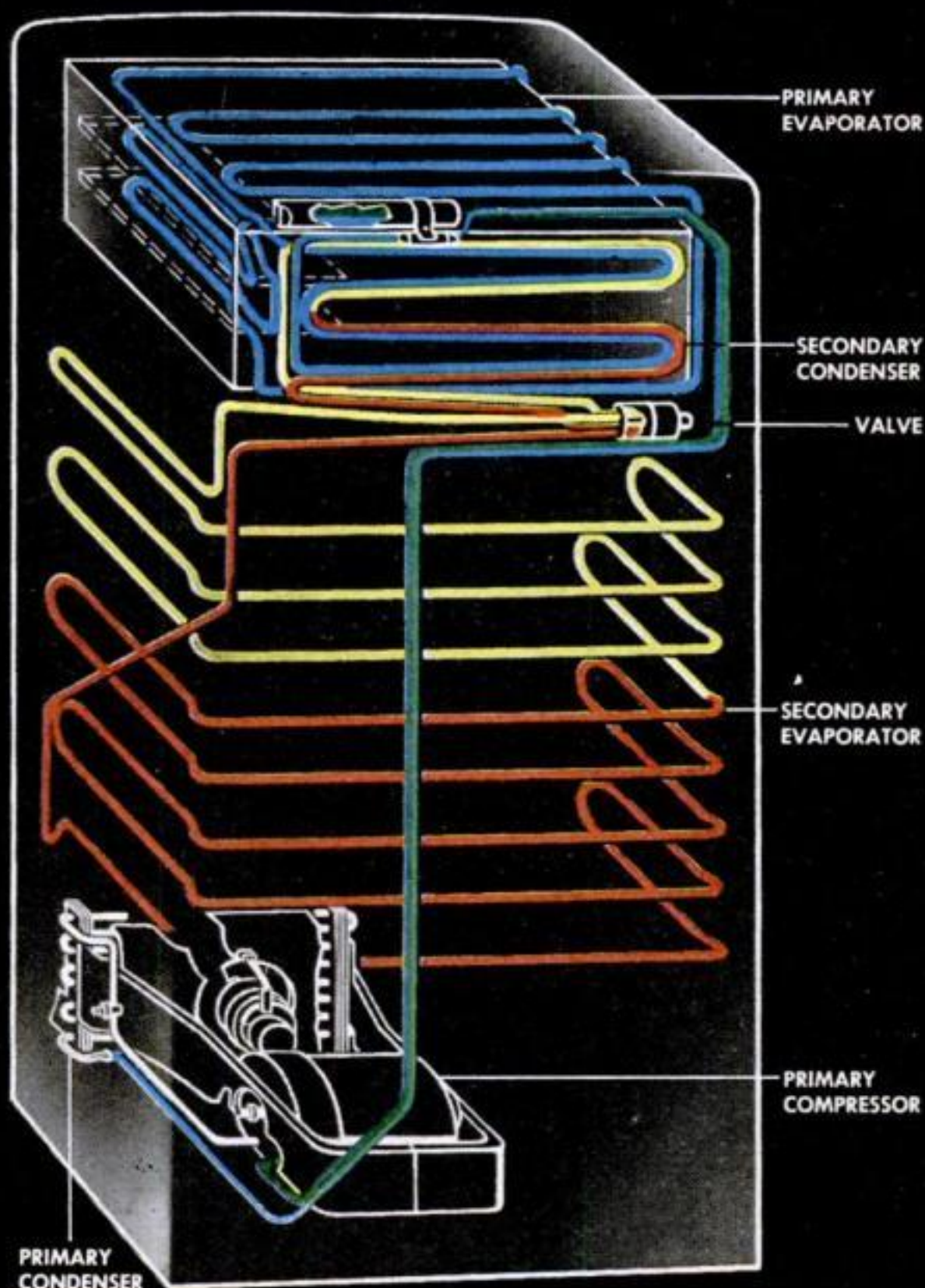
Two-in-one refrigeration depends on separate systems. Compressor operates primary system that keeps freezer section at 0° F. Primary pipes also cool adjoining pipes of secondary system, which works by gravity and vapor pressure. Key of the twin systems is the valve in secondary unit; set manually, it opens and closes automatically to control refrigerator temperature.

PRIMARY SYSTEM

— LIQUID
— VAPOR

SECONDARY SYSTEM

— LIQUID
— VAPOR



L. P. BING

Freeze as You Please

BY FITTING both a home freezer and a refrigerator into one cabinet, and then making one compressor operate two cooling systems, General Electric engineers have put something new on the icebox market.

The combination, labeled Model NH-8, is only 30 inches wide and 63 inches high, but its top section is a 1.5-cubic-foot freezer section, and its refrigerator compartment has a volume of 6.7 cubic feet. Each section has its own door and temperature control, and each works independently. Frequent opening of the refrigerator puts no load on

the freezer, which ordinarily is opened only a few times a day for access to frozen foods or ice cubes.

The sealed secondary cooling system chills the walls of the refrigerator compartment, keeping it at about 38° F. With no exposed freezing unit, defrosting is unnecessary. Moisture condenses on the walls, runs down through a trap into a concealed pan, and evaporates. (The freezer, operating between 0° and 10° F., does require defrosting, but only twice a year.) This system also keeps humidity high in the refrigerator; moist foods need not be covered to keep them from drying out.

Built into the left wall of the NH-8 is its final convenience: a special compartment, warmed by a small heater, that keeps butter just right for spreading.

I'd like to see them make...

Drawings by Lester Fagans

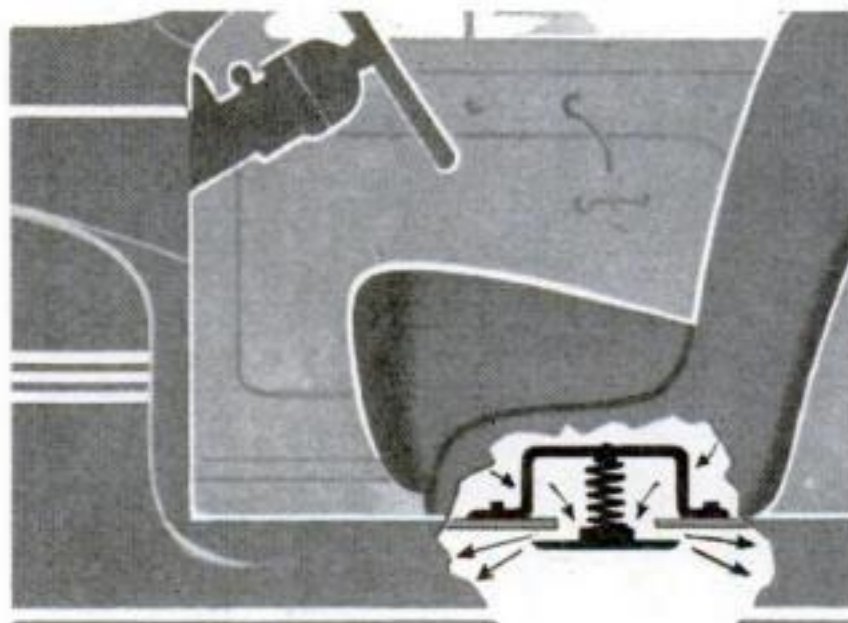
Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science will pay \$5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.



The World on Balloons. A rubber balloon with a good map of the world printed on it would serve as an inexpensive reference globe. Every child could have his own.—F. H. Van Benthuyzen, Hopewell, Va.



Target Banks. I'd like a coin bank that would open automatically when I saved a previously set "target" sum. Once set, it should not open until this amount has been saved.—Stephen Bartlett, Beaumont, Tex.



Door Valves on Cars. When the windows are up, air pressure often makes it hard to close the door on a new car without slamming it. A simple valve would let air escape.—J. T. Lindley, South Bend, Ind.



Mustard in Tubes. Packaged in collapsible tubes like toothpaste, mustard would remain clean and could be spread neatly on hot dogs. Ketchup might come in tubes, too.—E. H. Feck, Tiffin, O.



A Wall Flour Sifter. It should be large enough to hold a regular paper flour sack, which would be upended into it. A crank or a push-pull rod would sift flour as needed.—Mrs. D. Roach, Burlingame, Calif.

Apple's Flavor Squeezed Into New Delicacies



Natural flavor extracted from the apple gives these products the tang of orchard-fresh fruit.

How scientists solved the problem of the apple's lost flavor and then captured its essence in a bottle.

By John P. Arnold

IF YOU must have your apple a day, you can now enjoy it in a variety of forms. A new method of extracting pure apple essence from the fresh fruit has brought the

flavor and aroma of the ripened McIntosh or Red Delicious to candies, ice cream, soda pop, gelatin desserts, and many other home-made and commercial products.

And if current experiments are any indication, you'll soon be able to chew your apple in chewing gum, inhale it in cigarettes, smell it in perfume, or enjoy its taste in apple-flavored medicines.

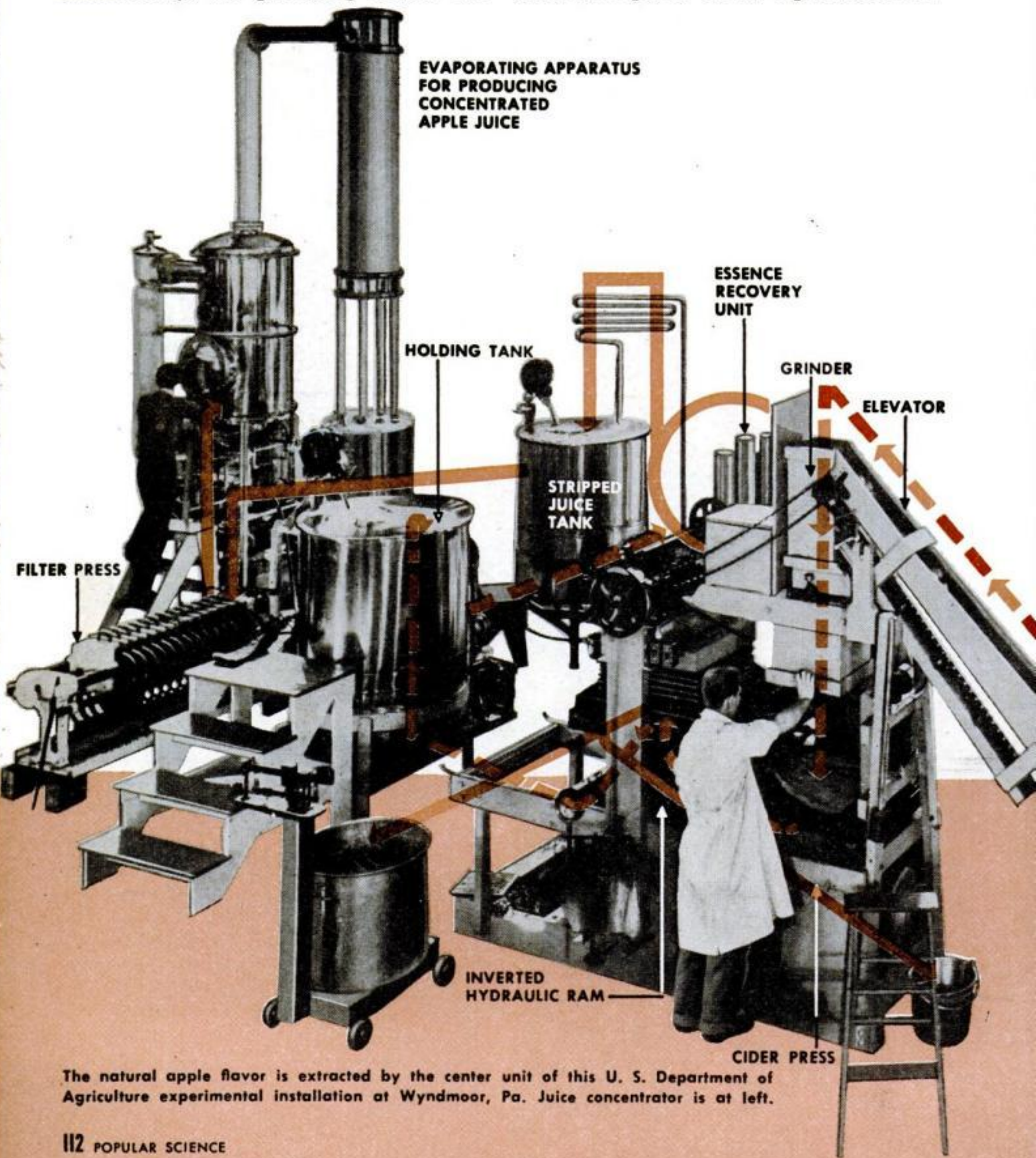
It all stems from the apple industry's

problem of producing a concentrated apple juice that would keep for year-round sale and still have the flavor of fresh cider, which is perishable. Processors had learned that by adding an enzyme, Pectinol A, they were able to break down the pectin that causes gelling. Thus they produced an apple juice of about 75 percent solids; it had excellent keeping qualities and could be shipped in tank cars without special precautions. But, unfortunately, the processing robbed the

juice of most of its flavor, and it couldn't compete with fresh apple cider.

When the processors tossed their problem into the collective lap of Department of Agriculture scientists, the latter had a theoretical, but wholly logical, answer: extract the flavor from the fresh apple; process the fruit; put the flavor back in again.

"Yeah, brother, but how do that?" was the wail. "Don't know, but let's try," the scientists replied. So an experimental sta-



The natural apple flavor is extracted by the center unit of this U. S. Department of Agriculture experimental installation at Wyndmoor, Pa. Juice concentrator is at left.

tion was set up at the department's Eastern Regional Research Laboratories, at Wyndmoor, Pa. There, for several years, the apple has been given such a thorough going over that it has fewer secrets than a presidential candidate.

After much trial and error, the researchers hit on a way of capturing the sources of the natural apple flavor, located for the greater part just under the skin. The process consists of first heating the juice of pressed apples to volatilize the flavoring elements. Then the vapor is mechanically separated from the juice, concentrated by fractional distillation, and condensed.

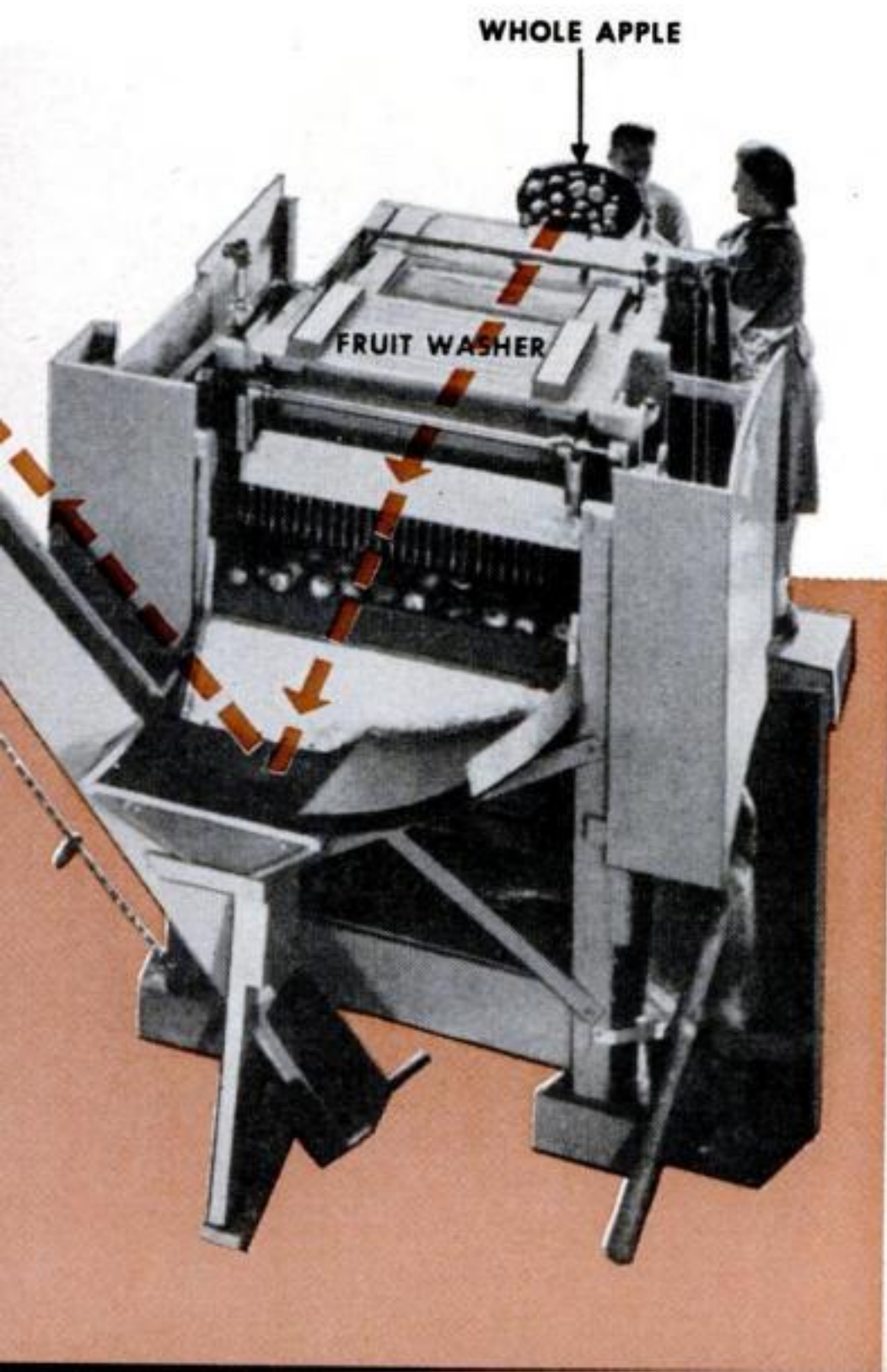
The result is a clear, colorless liquid, a 150-fold concentration of the juices from which it is extracted. And the stuff is so powerful that a few drops released in a room carry you right back to the old orchard.

This separation of the apple flavor has been a shot in the arm for the apple industry. The essence is first recovered from the fruit. The juices are then concentrated and

reflavored with the essence, with the result that there is no apparent difference between the processed product and apple cider fresh from the presses. Another advantage is that peelings and other parts of the apple, often waste products, can now be used. Also, apples of inferior flavor can be squeezed for juice-making and then spiked with the essence of the more desirable varieties.

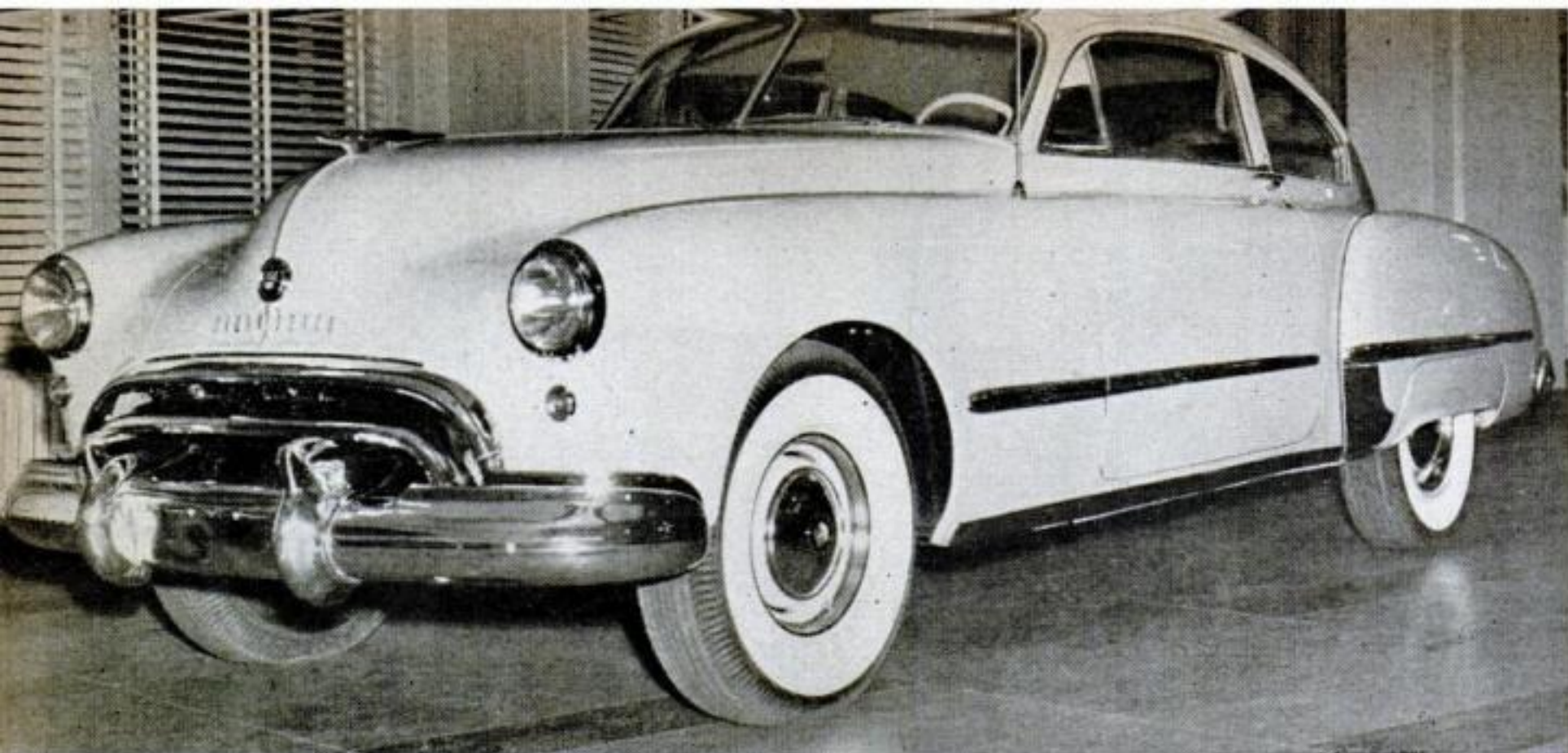
Six companies already are selling the essence, and 60 others are installing the equipment for making their own products. Other fruits and berries are also in line to have the juice knocked out of them.

Since its extraction, the new essence has found many other uses outside the apple industry. Perfume-makers are experimenting with it. Research chemists say it may serve as a bait for insect poisons and as a mask for the nasty taste of castor oil and other medicines. The housewife will soon have a bottle of it on her kitchen shelf to flavor a dish of ice cream or a gelatin mix. Since the day of the Big Apple, this fruit has never had such a big moment. **END**



Horse Laughs at Ice

ICE in his water trough doesn't bother the horse whose master has installed the Westinghouse heating disk shown above. A round piece of metal, it contains a 500-watt heating element giving off enough heat to keep the water ice-free. It costs less than five cents a day to operate.

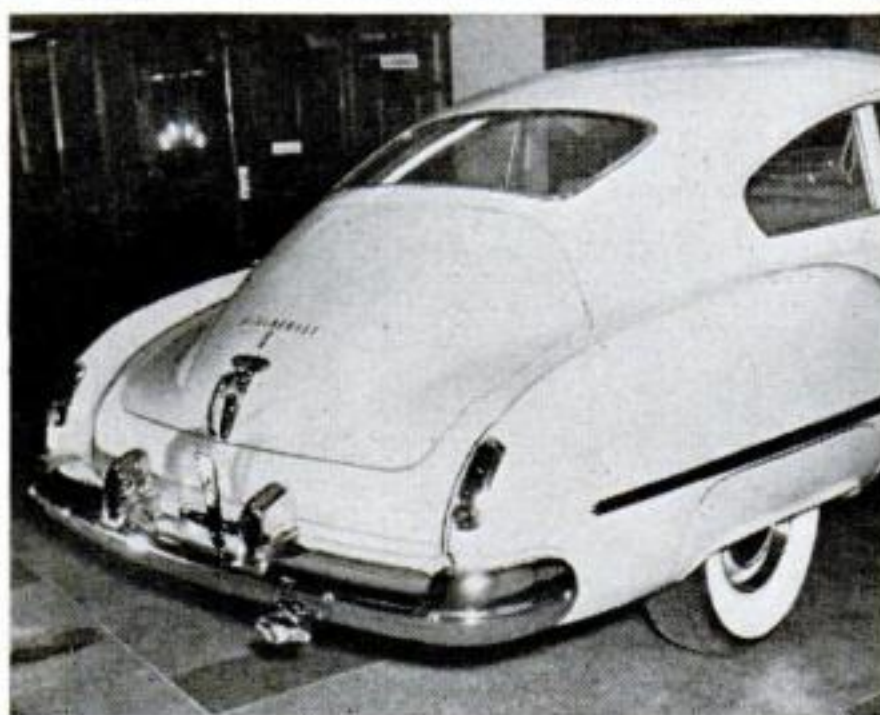


New Olds Gives Wider View

THERE'S better vision all around from the striking "Futuramic" ① body that Oldsmobile is introducing this year for its "98" series. Curved glass is used in both windshield and rear window, the side windows are larger, and the hood is lower.

An advanced example of teardrop design, the new body comes as a convertible, four-door sedan, or two-door club sedan (above). Front fenders and hood flow smoothly into the main shell in streamline tradition, but the rear fenders are distinctively styled, narrow in cross section, and rise well above their junction with the sloping rear deck.

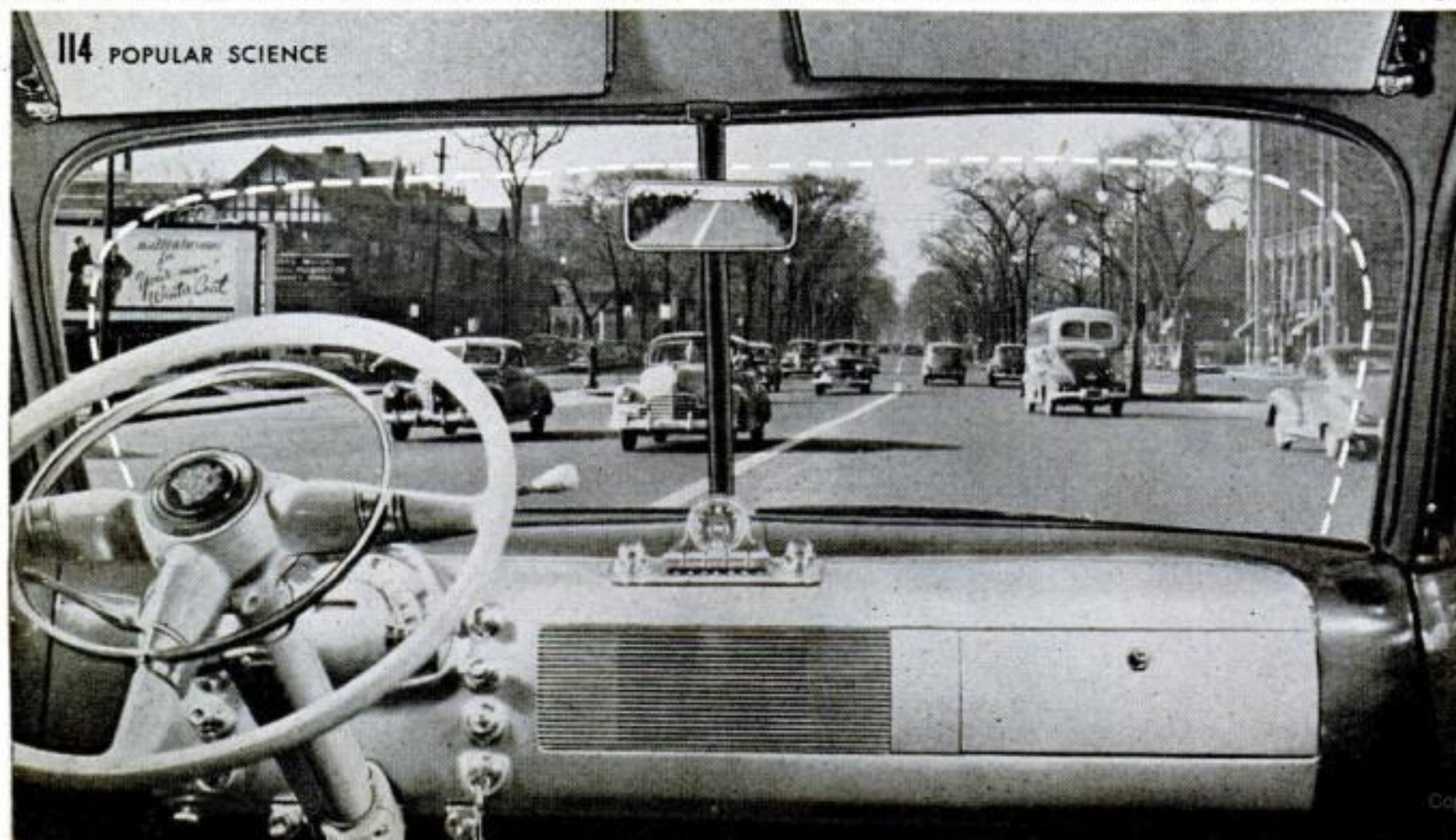
Built on a wheelbase of 125 in., the body is 213 in. long, 78¾ in. wide, and 64 1/32 in. high. Seats are about 2 in. wider.

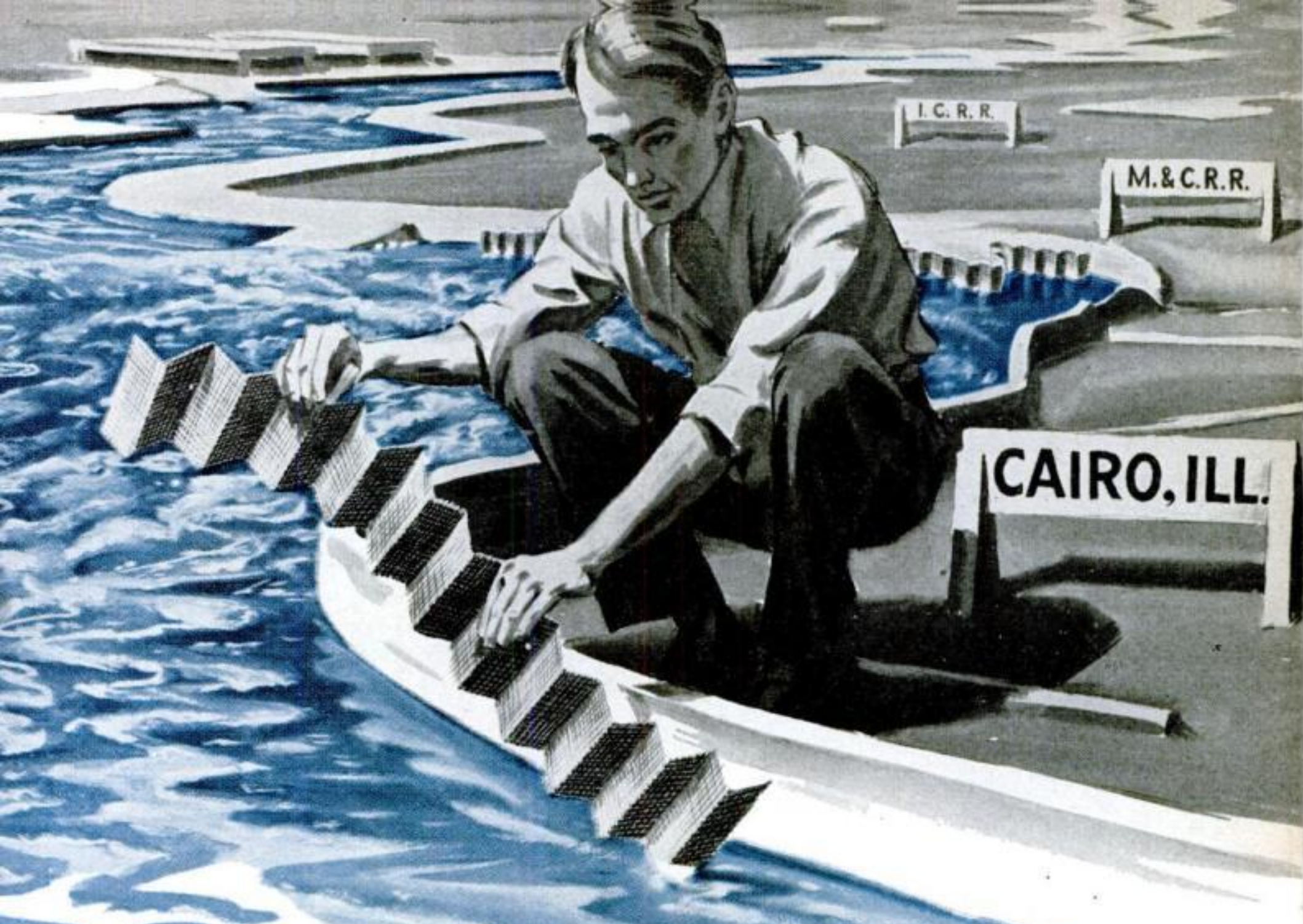


All models in the "98" series are powered by a 115-hp., 8-cylinder, in-line engine, the horsepower rating having been raised from 110 by adoption of a high-compression head with a 7 to 1 ratio. All "98" series models are equipped with Hydra-Matic Drive ②.

Other models are unchanged from 1947.

Dash controls are near driver and the new windshield is larger than the old (dotted line).





The World's Biggest Working Model

This colossal effigy of Old Man River will make little floods to help America protect herself against big ones.

By Volta Torrey

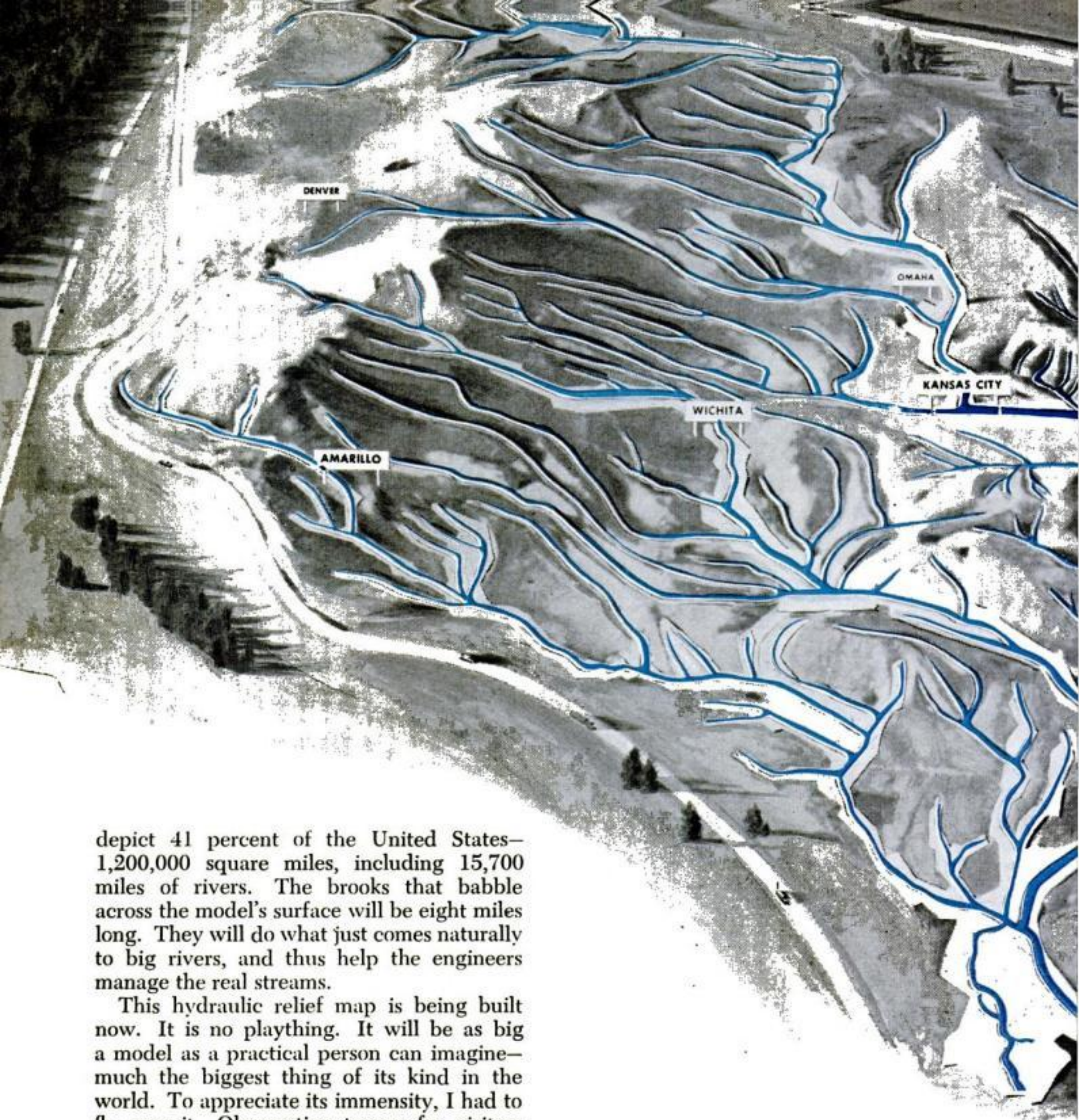
VICKSBURG, Miss.—The Colonel will drive around the make-believe Mississippi Basin—from Chicago to Pittsburgh to New Orleans, and back via the Texas panhandle, Montana, and Minnesota—in seven or eight minutes. As the Colonel reckons time, however, this 30-m.p.h. trip will have taken about 24 hours.

“Better send a man with a broom and dustpan over to clean those leaves out of the Missouri River near Omaha,” he may suggest when he returns to the control house.

“Yes, sir, I’ll have it done before March 5,” the engineer may reply. “This is February 27, 1945. How about having lunch now? We can be back in plenty of time to see what the Ohio River does on March 10.”

Such Alice-in-Wonderlandish remarks will be commonplace at Clinton, Miss., in the 1950s. Men will speak of minutes as though they were days, of feet as though they were miles, and of ripples in a test tube as though they were floods. This will be sensible, because the officers and engineers at Clinton actually will have North America’s greatest river system in a concrete test tube. It will be 1,500 yards long, 1,300 yards wide—a working model of the Mississippi and all of its important tributaries.

This model will cover 220 acres. It will



depict 41 percent of the United States—1,200,000 square miles, including 15,700 miles of rivers. The brooks that babble across the model's surface will be eight miles long. They will do what just comes naturally to big rivers, and thus help the engineers manage the real streams.

This hydraulic relief map is being built now. It is no plaything. It will be as big a model as a practical person can imagine—much the biggest thing of its kind in the world. To appreciate its immensity, I had to fly over it. Observation towers for visitors may be built when it is finished, but the hundreds of men now employed on the site are not preparing a mere exhibition for tourists. This effigy of Old Man River is expected to make him behave better.

Authorities on potamology (the science of rivers) believe that floods actually will be warded off by this project of the U. S. Army's Corps of Engineers and the Waterways Experiment Station of the Mississippi River Commission. The model will cost nearly \$6,000,000, but it may turn out to

be a bargain. For it will save money in two distinct ways:

1. On this imitation of the restless Mississippi and its 40 satellites, the great floods of 1912, 1927, 1937, 1945, and 1947 or any other year can be re-enacted. Conditions that may arise in the future also can be simulated. Thus, the model will settle arguments that have raged since the French started building levees at New Orleans in



Thirty-one states (area shown in white at right) will be represented by this grassy valley full of midget rivers. Pumps will supply water from sump (at left). After simulating river currents, water will flow back to sump through underground pipelines from 8 to 30 inches in diameter. Entire model will be operated from that little building above "Chicago."

1717 about where more levees, dams, reservoirs, etc., are most needed and the types of structures that will be most useful. That can save Uncle Sam billions. But—

2. The Midwest's rich, green, flat valleys now are threatened by man-made as well as natural floods. There are 200 reservoirs on streams that pour into the Mississippi. More are being built. Still more are contemplated. The danger of floods is increased

every time another such structure is built—unless it is properly operated. This model will show the operators of these dams and reservoirs how to operate them so as to protect their own neighborhoods without creating floods elsewhere.

Suppose, for example, that the men in charge of the 4,100,000-acre-foot^o reservoir in Kentucky, the 3,350,000-acre-foot reser-

^oAn acre-foot is the amount of water needed to cover one acre to a depth of one foot.



Model builders use hundreds of these metal patterns to make small-scale replicas of main river beds, levees, and spillways. Bottom strips of the templates will be left in the concrete.



Concrete is poured and molded to conform to top edges of suspended templates. Rails and supports will be removed after it has set. Minor details are molded in the surface by hand.

voir in Montana, and several others in between were to release water independently. The result might be a catastrophic flood at Memphis.

Suppose, however, that the reservoir operators first wired the scientists in Mississippi. "Reproduce present conditions on the rivers," the director could tell the engineer in charge of the model, "then add water at rates and times corresponding to those at which these reservoir operators say they'll be discharging it."

"Gosh, boss, this looks bad," the engineer might report eight hours later, and lay a sheet of figures on the director's desk.

"Sure does," the director might agree. "But don't worry. I'll phone Hank Johnson up at Fort Peck. He and some of the others can change their schedules enough so that nobody will get wet at Memphis, or anywhere else."

Billion-Dollar Menace

How many lives, and how much property, can be saved by such fast, sure teamwork? There's no telling, but recent history is enlightening:

Last summer's floods in the Midwest took 16 lives and caused damage estimated at \$1,000,000,000. Very little of that damage was covered by insurance, because the people who live along many of these rivers cannot buy flood insurance the way they buy fire insurance. This estimate, moreover, takes no account of the misery of 48,000 persons whose homes and shops were left caked

with stinking mud, or the sums spent by the Red Cross and other relief agencies. Man-made floods could be equally costly.

This model, in short, is intended not only to save the taxpayers' money by helping the engineers design protective structures, but also to save farmers, merchants, and manufacturers from flood losses that would result from injudicious use of existing structures.

Will it work?

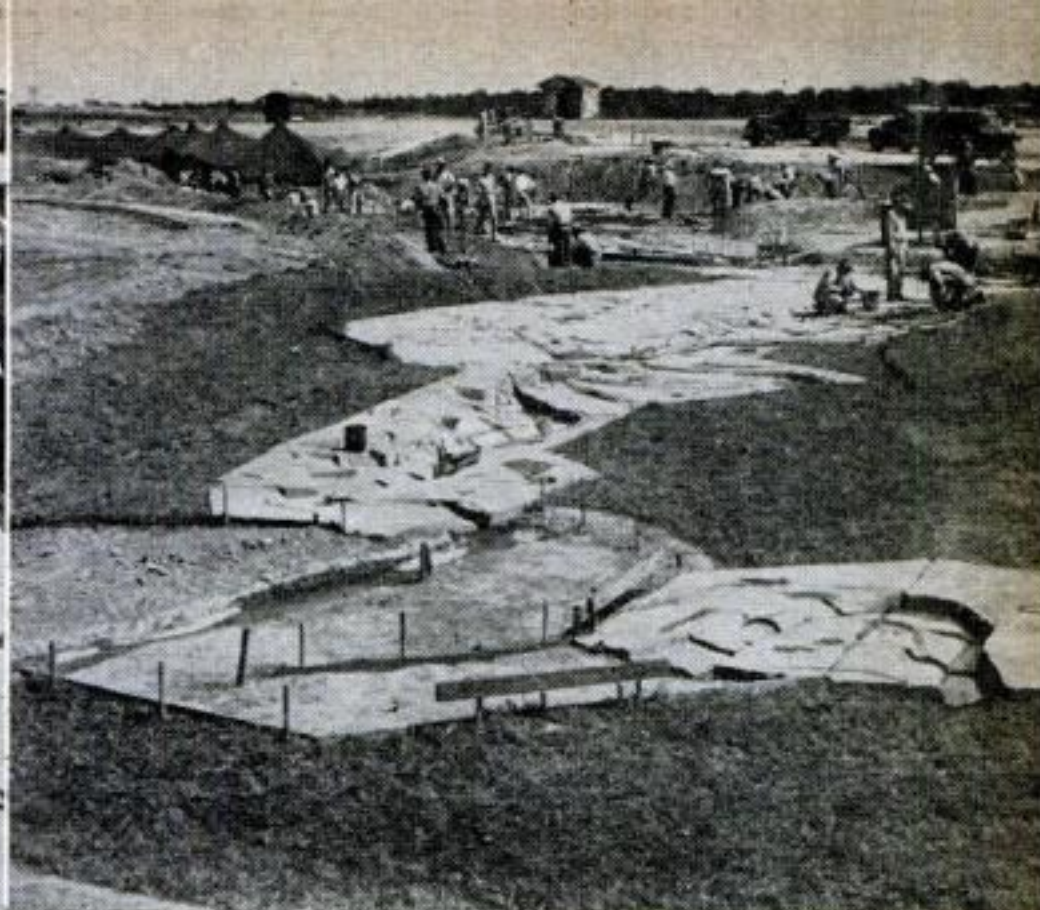
The engineers at the largest hydraulics laboratory in the world, the experiment station in Vicksburg, are sure that it will. They have built dozens of models of rivers and harbors. They have been solving difficult problems with these models for 18 years. They even have a thoroughly tested, 2½-acre model of the lower part of the Mississippi, built on the same scale as the big one now under construction. And it works fine.

Horizontally, one foot on the big model will represent 2,000 feet of the earth's surface. Vertically, however, one foot on the model will represent only 100 feet, because if the vertical scale were the same as the horizontal scale, the rivers would be too shallow and the currents too weak to be measurable. Actually, the currents in the model rivers will be from one-seventh to one-eighth as swift as those you'd have to buck if you were in a rowboat on the real streams, and 1,000 gallons per minute will suffice to portray the 1,500,000,000 gallons per minute of a major Mississippi flood.

The site for the big model, several miles from the Vicksburg laboratory, was chosen



Engineer checks handwork on complicated bits of bed. Sections of upper Mississippi, Arkansas, and Missouri rivers are being finished first because of urgency of problems in those areas.



Completed model will consist of many strips of concrete like this one representing the Arkansas near Little Rock. Gutters will keep rainfall from draining into working parts.

because of its natural approximation to the desired dimensions. Even so, 1,000,000 cubic yards of earth had to be moved. The knolls that represent the Appalachian slope rise 20 feet now, and those representing the Rockies rise 50 feet above the model's "sea level."

The river beds and valleys will be long, zigzagging strips of concrete, varying in width from a few feet to several yards. These are being built now. The rolling land between these winding waterways will be sodded. Signs will mark the sites of cities, and eventually there will be roads around and through the model.

Like a modern city's utility lines, however, the things that make the model tick will be concealed underground. There will be 15 miles of storm sewers, big water mains, and a maze of wires for electrical instruments below the surface. Water for the midget rivers will come from and return to a deep sump, which will resemble a swimming pool, somewhere near the site of Mobile, Ala., on the model. It will be nice, clean water because the kinds of research that the engineers have in mind can be done without mud. The pumps and instruments all will be operated from a control house "north of Chicago."

The pumps will be capable of delivering 10 times as much water as will be needed to simulate a Mississippi flood. This abundant supply will enable the engineers to operate various parts of the model separately, and study several problems at once.

Like designers of complex industrial plants, the architects of this colossal and intricate device built a "pilot" model first. But these planners bumped into a problem that seldom bothers industrial engineers—the curvature of the earth. To allow for this, Karl A. Dupes devised a method of combining a French mapping system (the Bonne projection) and a rectangular grid system—and thereby won himself a merit award from the Secretary of War.

Robots Will Run It

The gauges along the concrete channels of the model streams will be delicate electrical instruments. One of the several types now being considered will have a tiny motor suspended from an arm over the water. This motor will spin a set of pins, the points of which will barely touch the water at all times. The arm to which this pin wheel is attached will rise as the crest of a flood approaches and descend when it passes. Although a rise of a tenth of a foot in these creeks will correspond to a 10-foot rise in a genuine river, this instrument will yield as accurate data as can be obtained from human observers on the big streams. There will be from 600 to 800 such gauges.

These and other devices will do just about everything except shout "Mark Twain." They will make it astonishingly easy to conduct experiments. The switchboard in the control house will look like the switchboard of a power plant, and the operator will be able to twiddle his thumbs most of the time



Existing model of lower Mississippi shows how big model will look when in use. Note cutoffs in this part of river (near Greenville, Miss.) and levees extending for miles. The "woods"

are strips of wire window screening, a few inches high and pleated like an accordion. When model river overflows, these screens slow the water, just as trees do along a real stream.

because the whole river system will be managed for him by robots.

One of these "programmers" will have a dial about a foot in diameter on its face. A paper record will be placed on this dial. A tiny arm then will follow whatever curve is drawn on the record and send appropriate signals to automatic valves at from 200 to 300 inflow points. Some of these faucets will have fixed orifices of various sizes; others will have single openings that widen or diminish like camera shutters.

Another programmer will control the amount of water flowing out of the model, at from 60 to 70 points, when the operator wants this measured. Some of these outlets will handle only 10 gallons a minute; others will dispose of up to 800 gallons a minute. To change from a simulation of conditions that prevailed in 1947 to those that existed in 1917, the operator will simply change the records on the programmers. It will be no more difficult than putting records on phonographs.

A row of lights will show how the pumps are working and the operator will have a communication system by which he can bark orders to a helper out in the plant whenever

there's a hitch in the proceedings. The results of experiments run on the model will be jotted down, automatically, by a great battery of square-faced instruments.

These instruments will produce a continuous record of the tiny rivers' stages at points corresponding to those at which comparable figures are kept throughout the Midwest. There is no other known way, in many cases, of obtaining such data about floods before they occur. Models of this type are used only to solve problems so complex that they stump the experts' slide rules. And this model will differ from its predecessors in only two ways: it will be bigger, and the instrumentation will be much better.

Construction of this giant was started during the war by Maj. Gen. Eugene Reybold. Three thousand prisoners of war from Germany (where the hydraulic-model technique had originated) were employed on it. Among them were civil engineers, surveyors, and craftsmen of all kinds. They did about a third of the work. Civilians are continuing the job now under the direction of Col. R. D. King, who heads the Waterways Experiment Station. Completing the colossal model will take at least three more years. **END**



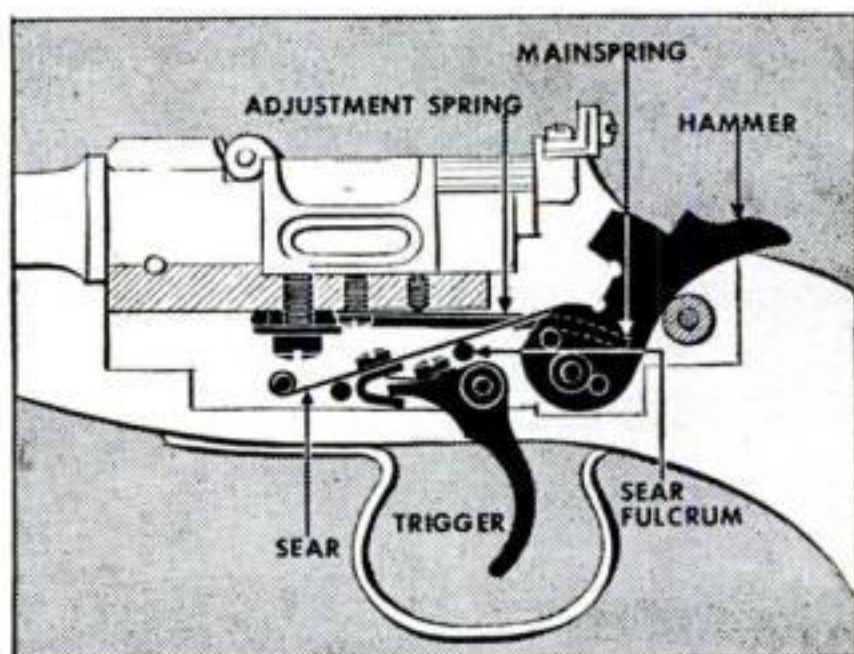
Slapless Trigger Improves Pistol Aim

A TARGET pistol with a new type of trigger reached the market a few weeks ago and promptly began hanging up records.

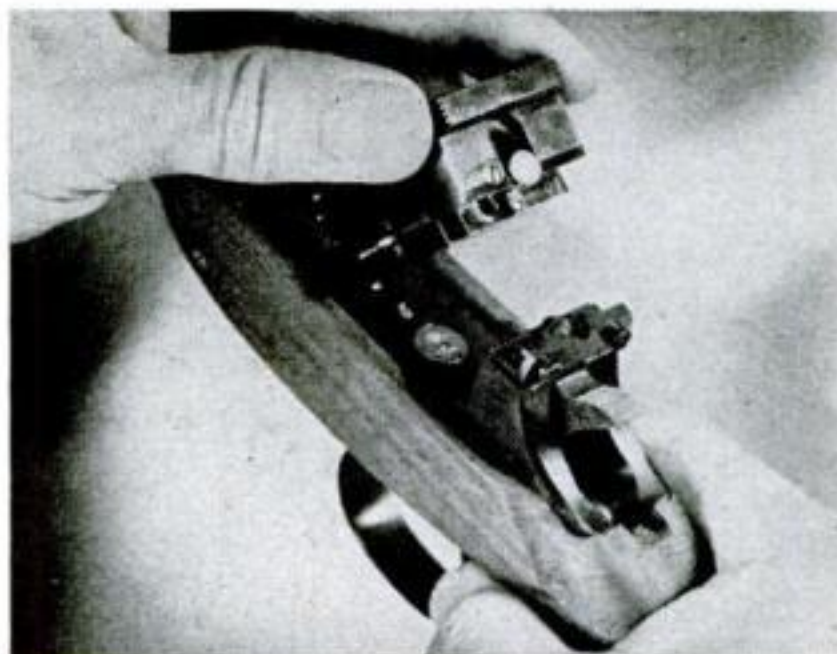
Known as the Tompkins, the .22-cal., single-shot precision pistol is designed to eliminate the errors in accuracy caused by unevenness of trigger tension and "slap." Called "glass-break" action, the trigger's smooth, steady pull, which can be adjusted

to desired tension, remains unchanged by the hammer's release. Move the trigger as little as 1/64 inch and it trips the hammer. It can be dry-snapped without damage.

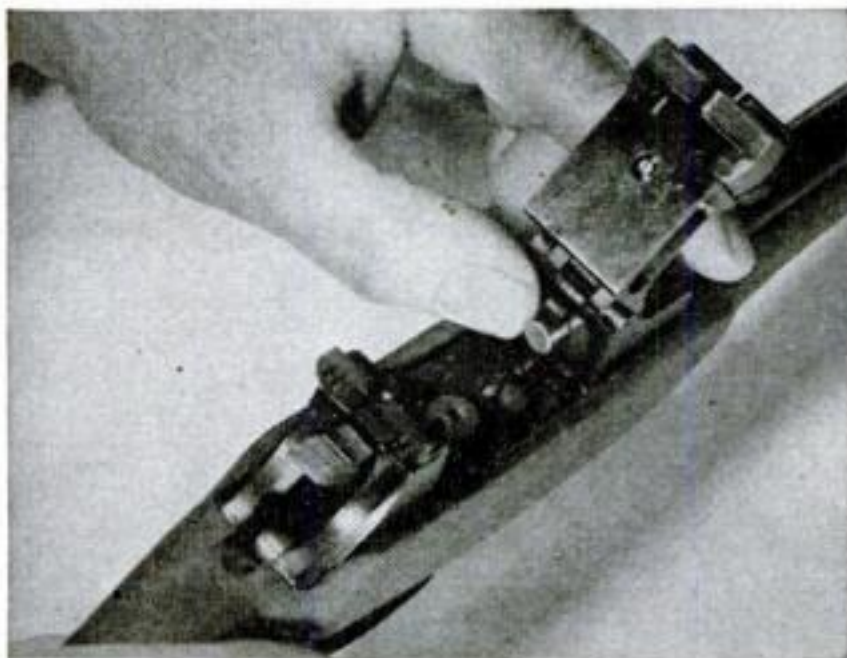
Made by the Varsity Mfg. Co., the pistol has an 8-inch tapered barrel. The 9 1/4-inch-radius sights have a 1/4-inch-per-20-yard click elevation adjustment and a manual windage setting. The pistol sells for \$88.26.



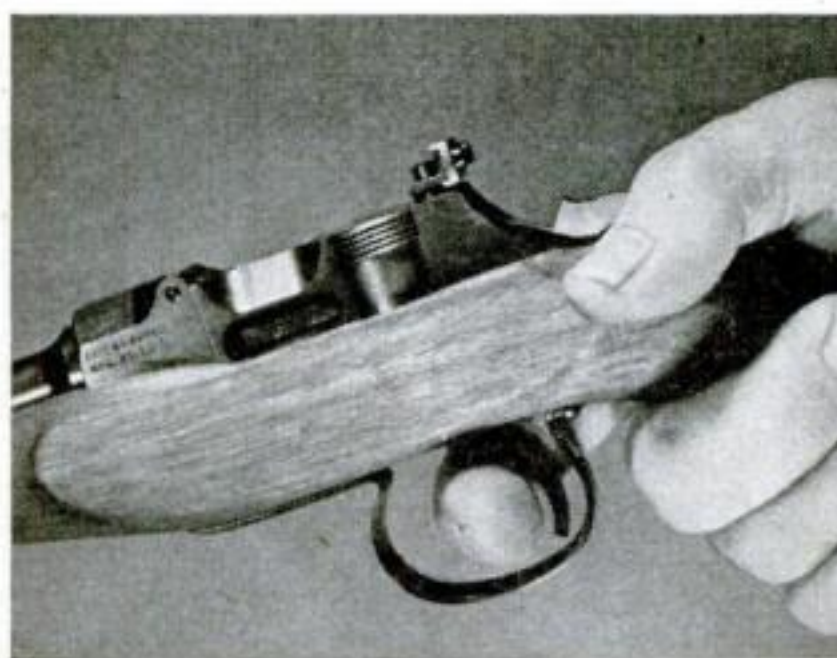
Smooth trigger pull is result of special sear spring, which is bent downward against fulcrum by trigger action to release hammer. Spring keeps trigger tension constant as hammer falls.



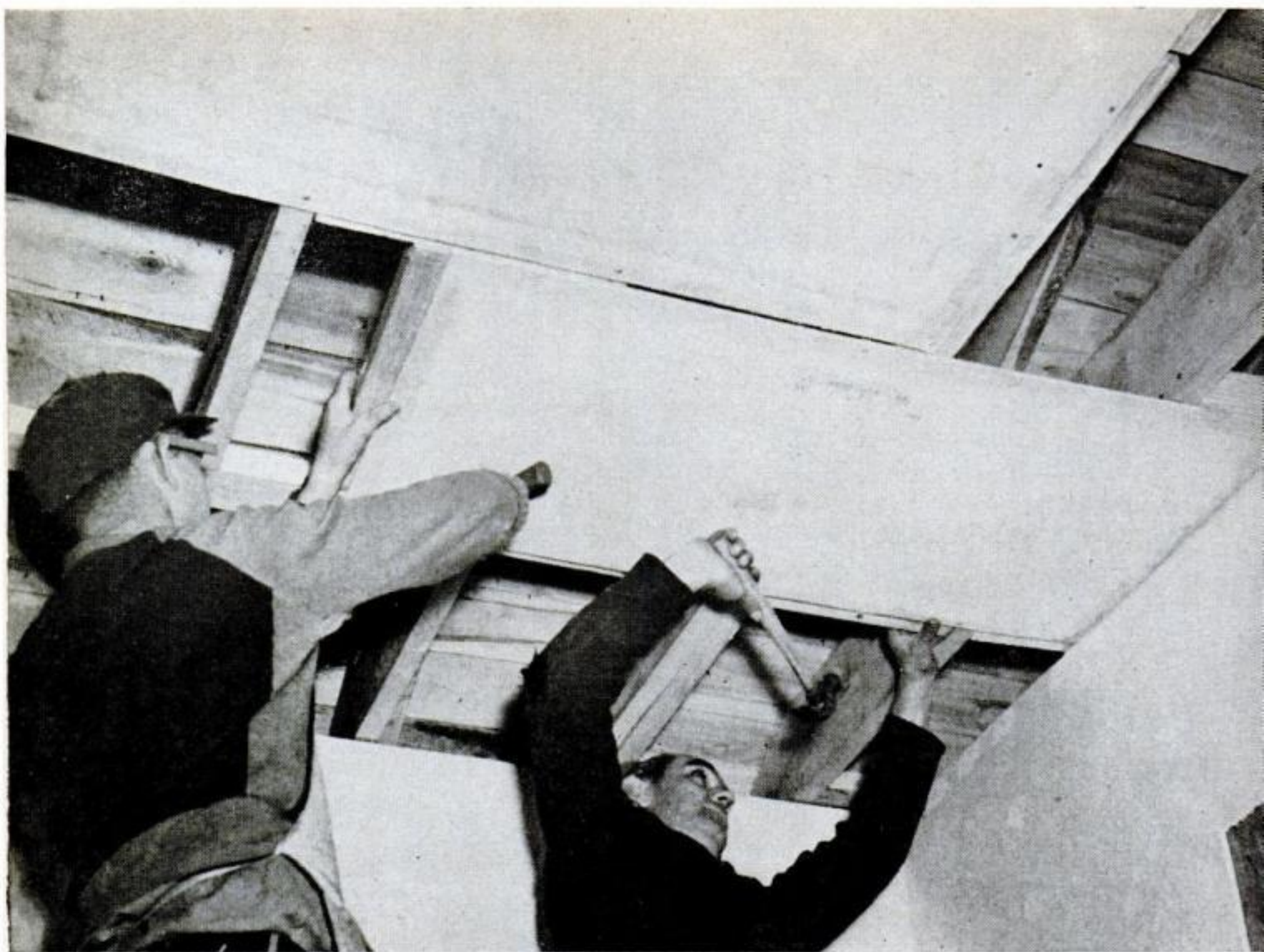
Entire breechblock swings up on front hinge when spring-tensioned wedge is lifted. Spring-actuated lock secures it when closed. Note rear end of firing pin in the center of the block.



Lifting breechblock ejects but does not throw empty cartridge, which is removed with the fingers. Maker stresses ease of loading without bullet damage or risk of premature firing.



Low line of sight aids holding and aiming. Walnut stock runs full length of gun, has channel under barrel for addition of balance weight. Cutout portions of breech help lighten the gun.



Radiant heat from ceiling panels like these may warm your home of the future. Each panel contains a thin sheet of rubber that conducts

electricity, generating heat. The panels look like wallboard and have a 2-in. nonconductive margin around the edge for nailing to joists.

Hide a Rubber 'Furnace' In Your Ceiling

SOMEDAY soon a thermostat on the wall may be the only visible sign that your home has a heating system. Furnace, chimney, pipes, radiators, and fuel storage tanks or bins will have vanished. To get heat, you'll just flip an electric switch.

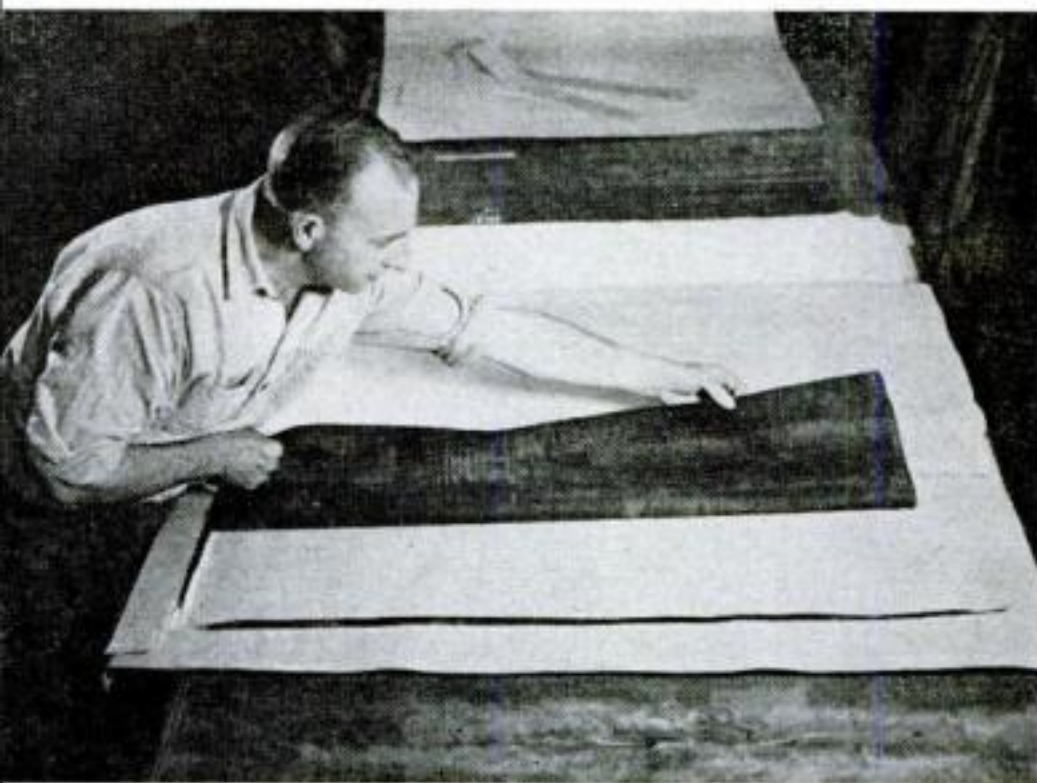
This exciting forecast is presented for its new radiant heat panels by the United States Rubber Company. For the secret of the new heating is a new kind of rubber whose reaction to electricity is just the opposite of ordinary rubber. Instead of an insulator, it is a conductor of electricity—and as it conducts, it heats.

Resistance elements of the new rubber are sandwiched between layers of insula-

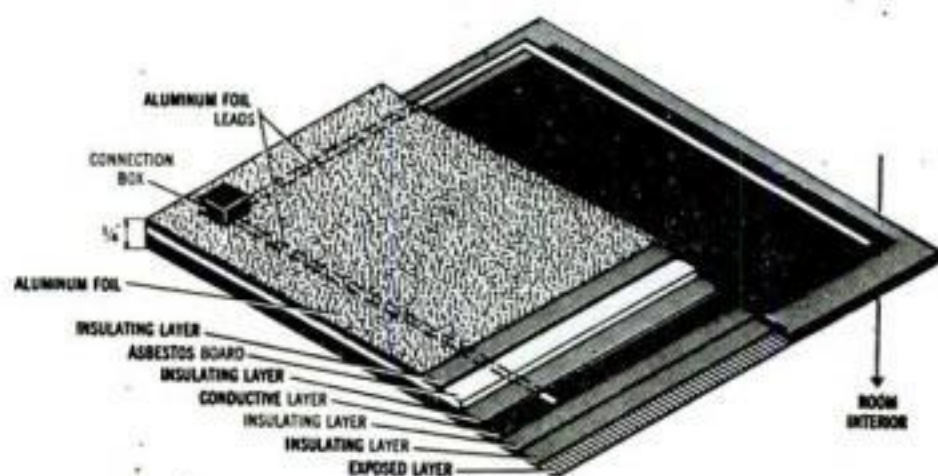
tion—there is no internal wiring except for two aluminum-foil leads. Fifteen minutes after a cold start the surface averages 100° F. Radiant energy from the panels is transformed into heat energy when it strikes any solid object. Like the sun, radiant heat panels warm you directly—in contrast to convection heating systems that first warm the air that warms you.

The four- by four-foot panels are connected in parallel and operate at 220 volts for top efficiency. As with other heating systems, thermostats—one in each room for local control—turn the panels on and off.

Starting at the outer edge, the panels cover about 70 percent of the ceiling area,



Conductive rubber bonded between insulating layers supplies the heat. Called **Uskon®**, this is natural rubber with carbon-black particles added to make it a conductor of electricity.



When completed, the panels are ¼-in. thick. Asbestos board makes them rigid and a layer of aluminum foil on top reflects heat down.

the center being covered with ordinary building board. The entire surface can be finished with paint, paper, or a light coating of plaster.

Tested in a number of homes in the past few years, the panels are now in commercial production. Compared with conventional heating systems, original cost is low. But before you rush out and buy, check on your local electric rates. If you pay more than a cent and a half per kilowatt hour, the panels are a luxury.

Engineers of U. S. Rubber have estimated the comparative costs of heating a six-room house in several cities with the radiant panels and with oil. Each is based on a 9,000-cubic-foot house, oil at 13 cents a gallon, and a wind velocity of 15 m.p.h.

The estimates for a full year: New York City, panels, \$299 at minimum electric rate of 2 cents, oil \$190; Buffalo, \$286 at 1½ cents, oil \$258; Atlanta, \$90.80 at 1 1/10



A **mannikin** in a test home shows that radiant heat warms you more than it does the air. At the left, air temperature at various levels.



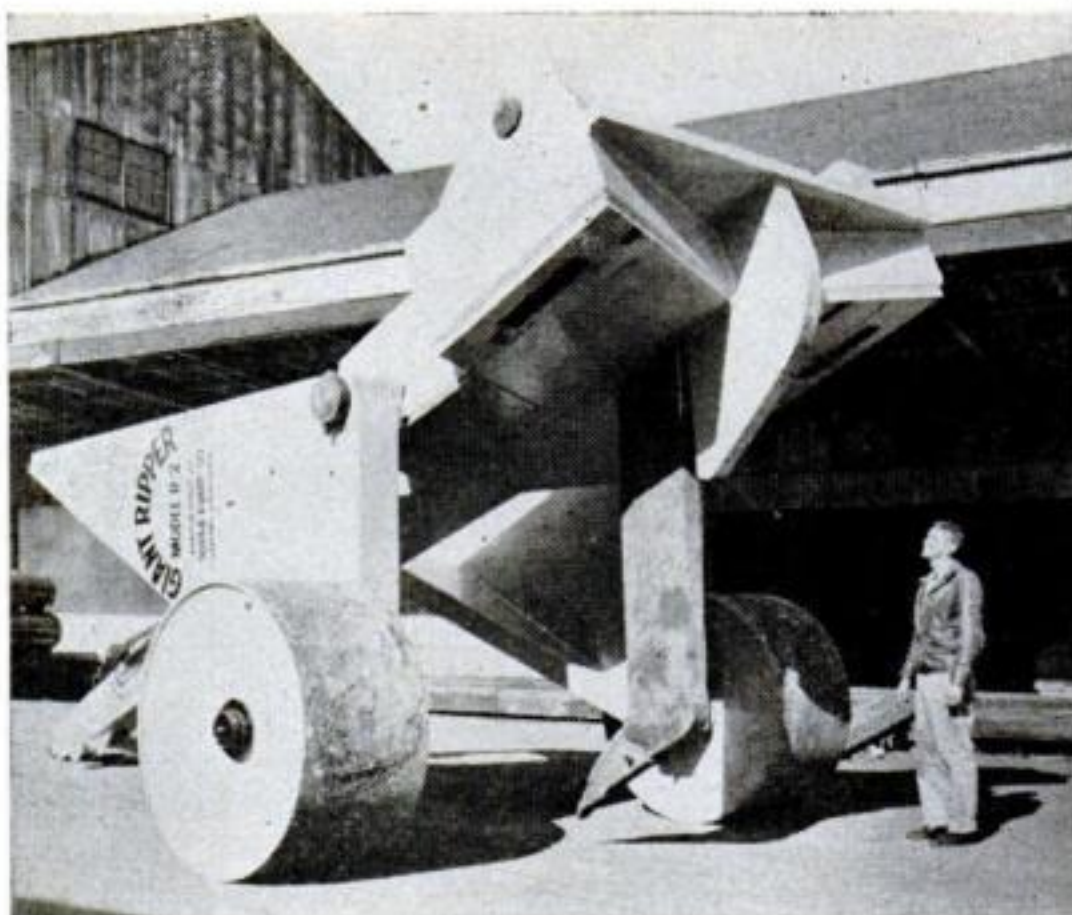
Small model home in New York City was used to demonstrate the panels this winter. Its first floor can be heated for around \$200 a year.

cents, oil \$125; Memphis, \$57.30 at 1½ cents, oil \$125; Dubuque, \$355 at 2 cents, oil \$258; Minneapolis, \$307 at 1½ cents, oil \$258; Denver, \$300 at 2 cents, oil \$190; Seattle, \$112.70 at ¾ cents, oil \$190; San Francisco, \$81.80 at 1 cent, oil \$125.

Earth Ripper Digs Deep

THE long steel tooth of this massive Juggernaut rips its way through hard ground and rocks to a depth of six feet. Called the Giant Ripper $\text{\textcircled{G}}$, it is designed to dig up and soften the earth ahead of ditchers on pipeline and cable-laying jobs.

When pulled by three tractors developing 450 hp., the 17-ton machine can handle three of the earth-rendering rooter shanks. Comparison with the man, shown in picture at right, gives an idea of the size of these teeth, which are 10 feet long, 5 inches wide, and measure 18 inches from front to back; the carrier itself is 26 feet long and 13 feet wide. Builders of the device, the Soule Equipment Co., of Oakland, Calif., have consigned the first unit to Saudi Arabia.



Phase Microscope "Sees" the Invisible

THINGS that ordinarily seem as transparent as window glass can be seen in all their detail with a new kind of microscope. The phase-contrast microscope, shown below, promises to be a valuable tool in can-

cer research and many scientific fields.

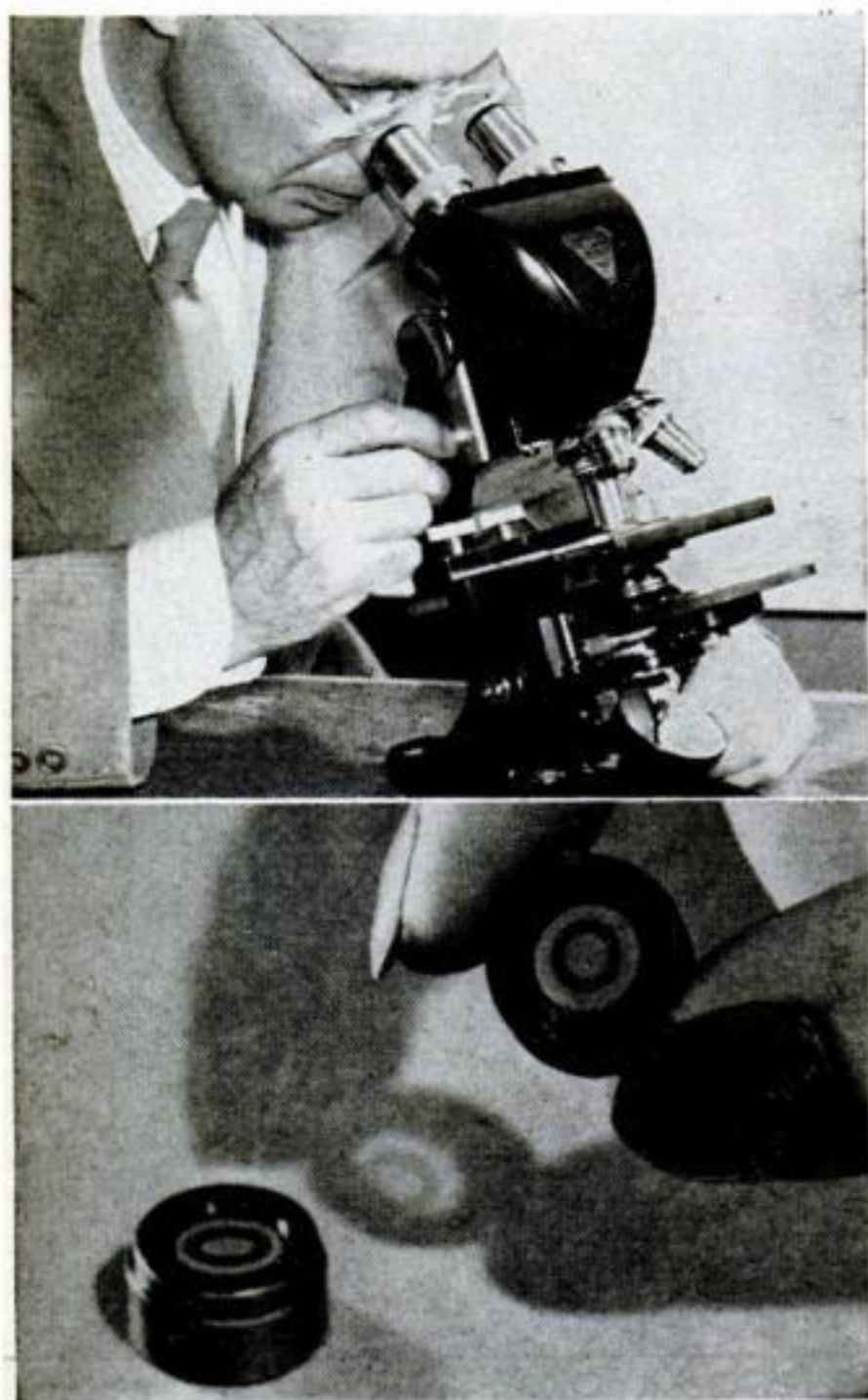
Two simple gadgets in the new instrument do the trick. One of the two plates shown at bottom left, is partly opaque and is mounted under the specimen so that the light illuminating it is limited to a narrow cone. The other plate, which goes inside the lens system, is transparent but has a ring coated with material that slows light waves.

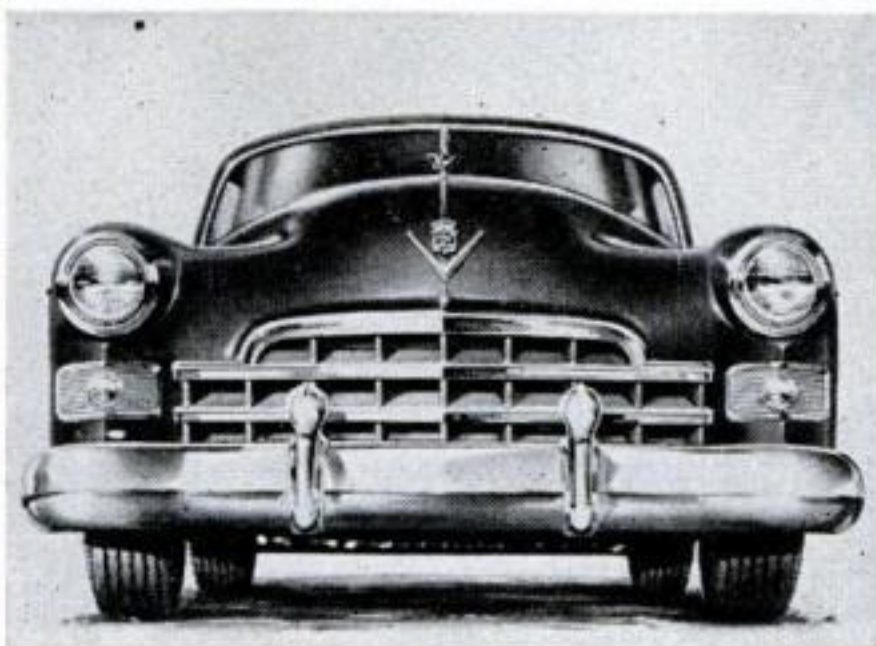
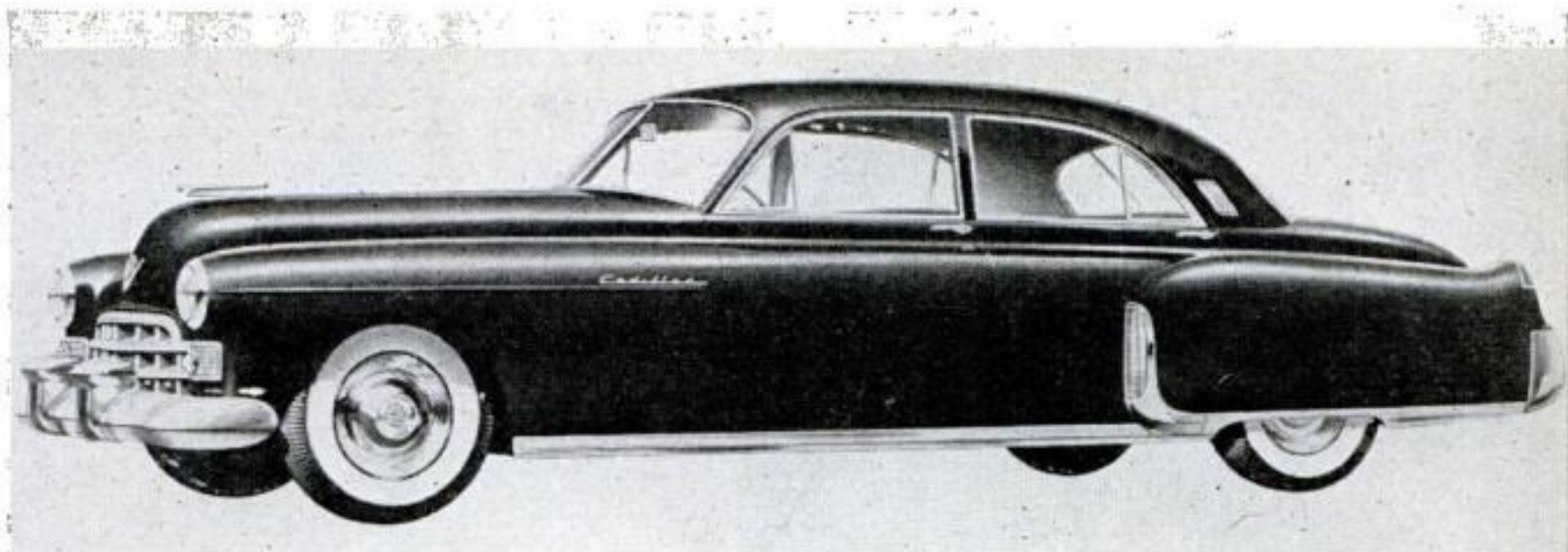
Between them, these plates slow up the light waves passing through a microscopic specimen so much that the light waves going through the invisible detail interfere with the waves going through the rest of the specimen. When this happens, the peaks of one set of waves coincide with the valleys of the other set, so that they cancel out. This forms a dark pattern that is a good image of the detail.

Detail in a microscopic specimen slows up light waves even without the phase-contrast attachments. This effect cannot be seen, however, unless the slowing up is enough to cause interference—as when the attachments are used.

Until the invention of the phase-contrast microscope, the only way to make transparent detail show up was to dye the specimen. This has the disadvantage of killing live specimens—and biologists often want to see their specimens alive.

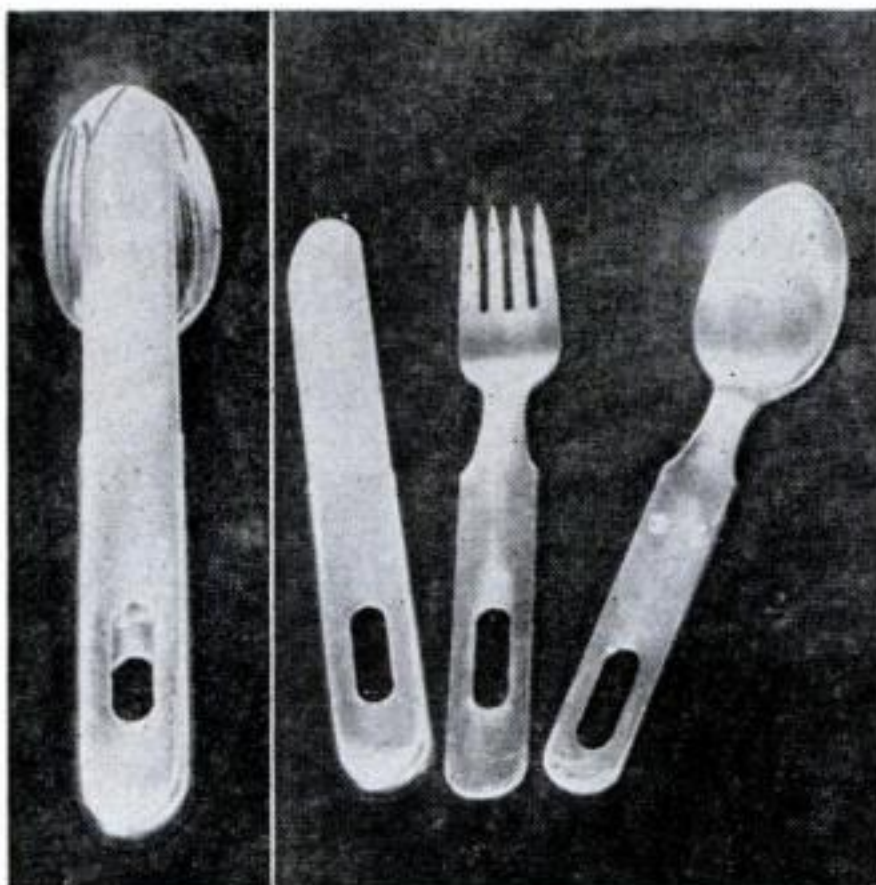
The invention of a German, Prof. F. Zernike, the phase-contrast microscope has been further developed here by scientists of the American Optical Co., and Bausch and Lomb.





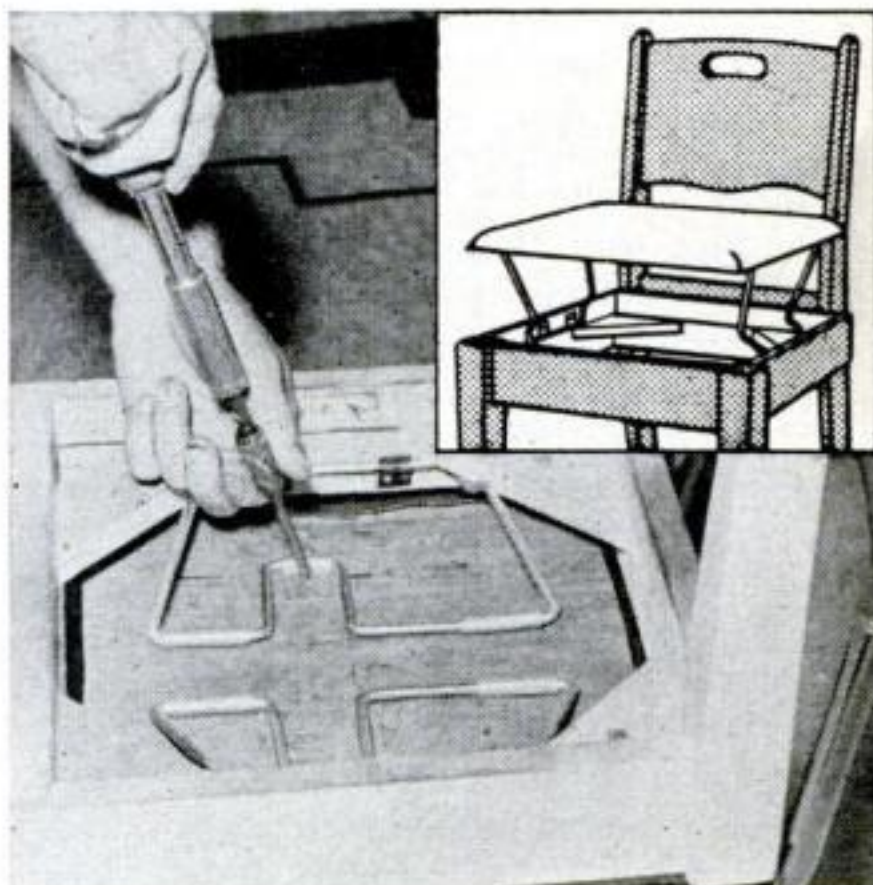
Power in Sleek Package

NEW note in the 1948 Cadillac is the distinctive rear fender that immediately catches the eye in the Series 50 five-passenger sedan shown above. Taking a leaf from aircraft design, the rear fenders are projected to form vertical fins. Directional lights have been fitted into the trailing edge. Front view, at left, emphasizes the car's traditional road-hugging lowness and massive width. The Cadillac 150-hp. V-8 engine continues to power all new models.



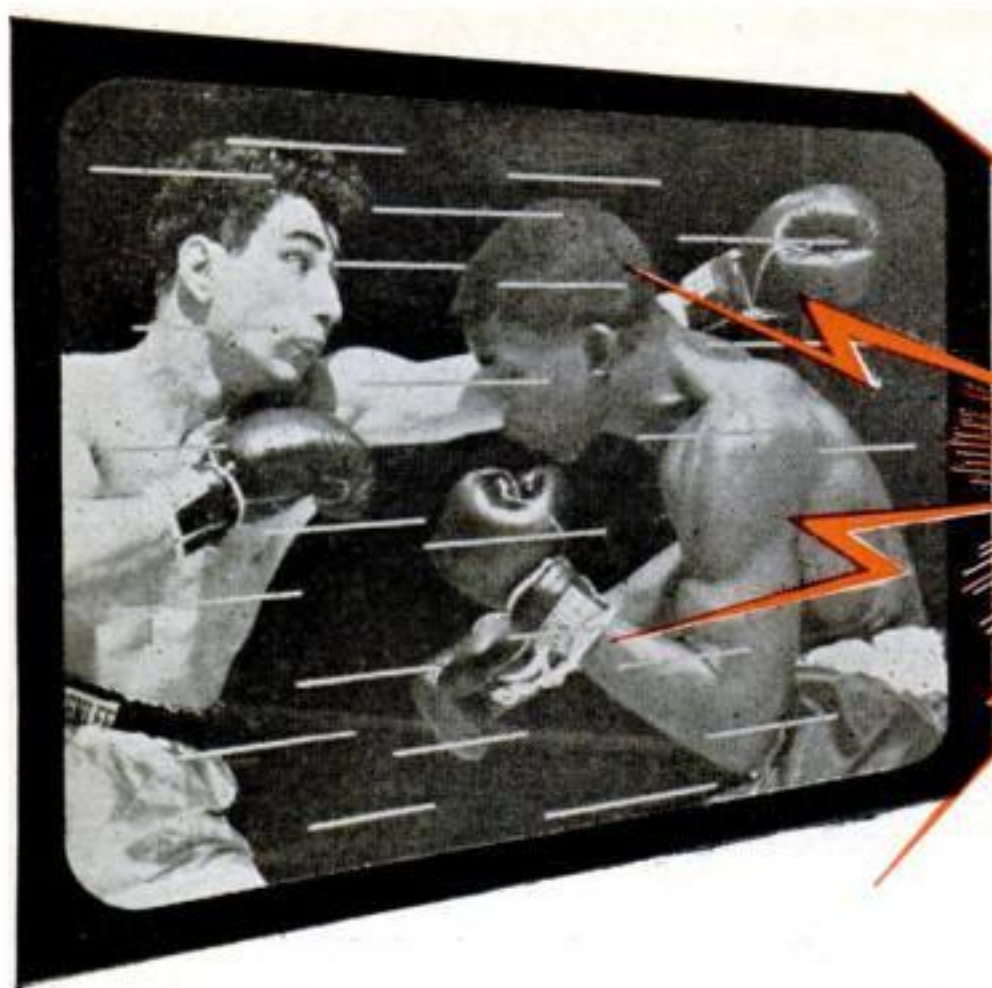
Chow Gear Improved

RATTLING knives, forks, and spoons can betray a night patrol to the enemy—but not with the new set of eating utensils developed by the Army. The three mess implements, made of stainless steel, nest together (at left), and can be carried in a uniform pocket. Slots in the handles allow them to be slung on the handle of a mess kit for washing. Old type set not only rattled, but was bulky and rusted in the field.

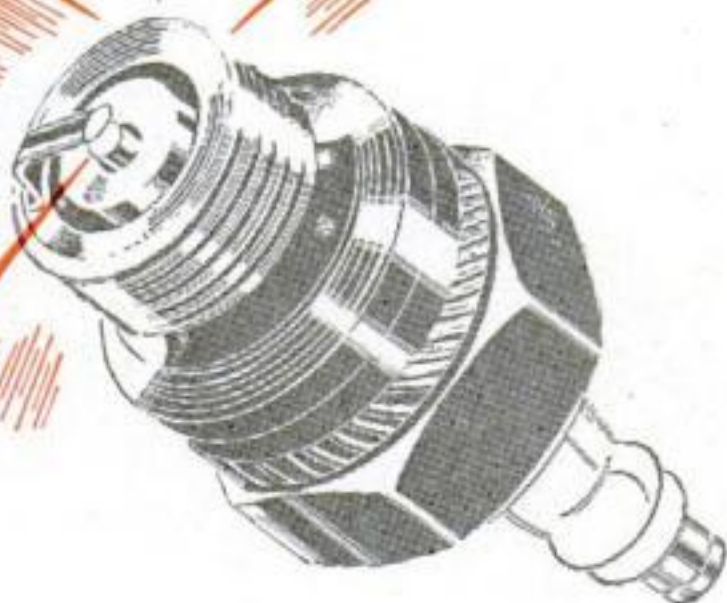


A Boost for Junior

JUNIOR, or junior miss, can now sit right up there with mom and dad at the dining table in an ordinary chair. But something has been added—a Hi-Lo[®] chair attachment. Consisting of two metal arms, it is easily fastened to the bottom of any chair seat. When screws securing the seat to the chair are removed, the seat lifts up and locks in place. The device is made by the Nu-Way Appliance Co., of Los Angeles, Calif.



Every spark plug, like other parts of ignition systems, is a miniature antenna. Unsuppressed, it covers everything from the broadcast band up, its effect growing worse with higher frequencies. Television (41 to 88 megacycles) gets it in the eye.



Unmaking Man-Made Static

Ignition noise, long a radio nuisance, faces a campaign designed to knock it out of the television picture.

AUTOMOBILE ignition systems have been producing spluttery noises in radios since the days of crystal sets. With television, the noises turned into visible streaks and blotches—and thereby set the stage for a large-scale attack on one of radio's oldest minor headaches.

The attack began during the war, when ignition interference was a major threat to vital military communications. To clear the air, a fleet of mobile Signal Corps test stations toured the country, teaching manufacturers how to build ignition systems that wouldn't sound off through near-by radios.

Static is fundamentally just like any amplitude-modulated (AM) radio signal. Frequency modulation will reject it, but short of using FM for every purpose, the only way to keep interference out of a radio completely is to suppress it at the source.

Eliminating ignition interference is a relatively simple operation, done quickly and easily on any car that carries its own radio. Resistors in spark-plug cables keep electromagnetic impulses from feeding back into the wiring, which would broadcast them; metal shielding around cables and other parts helps trap other impulses, and capaci-

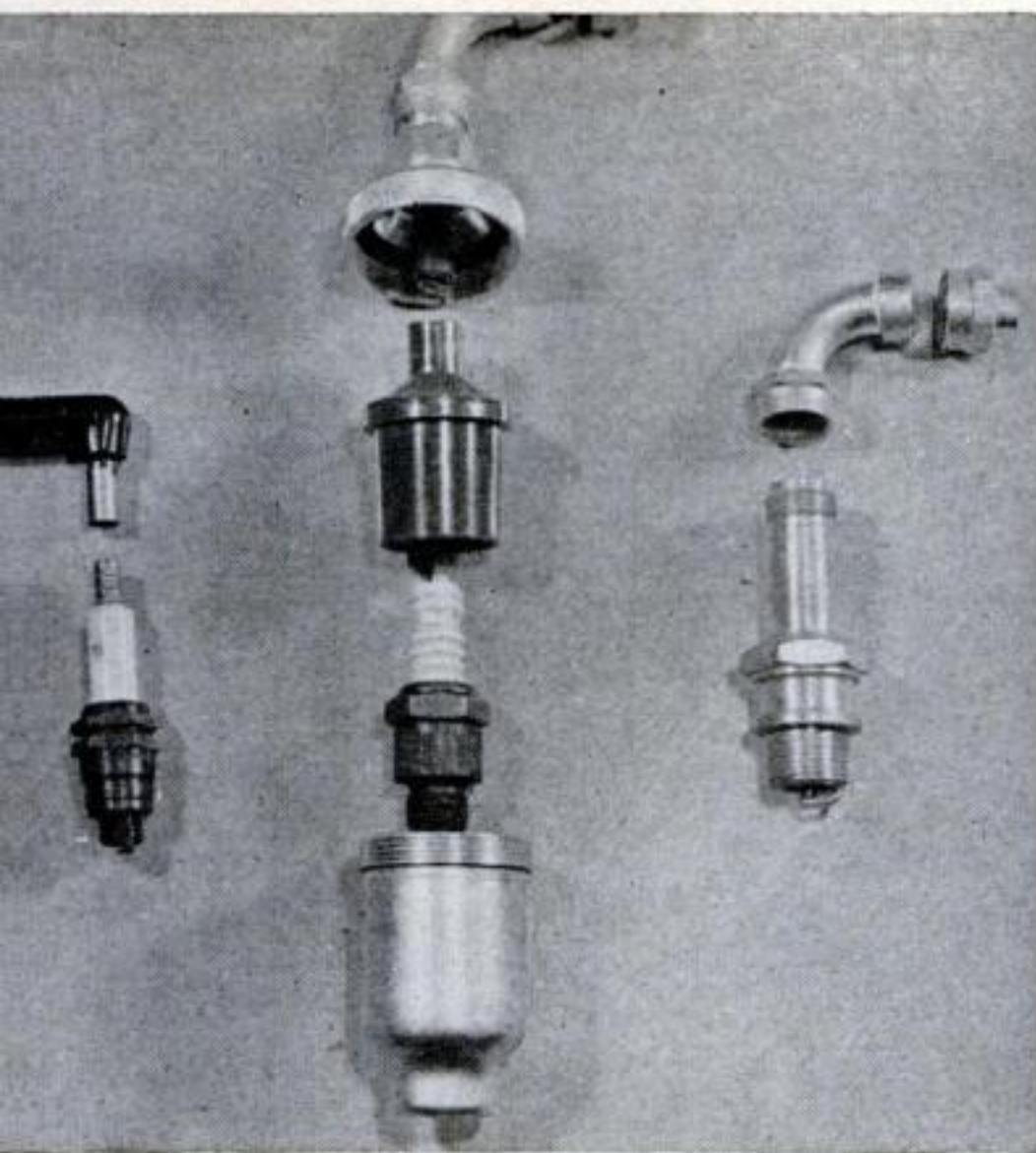
tors channel them to the chassis, which is bonded into a nonbroadcasting ground.

Experts at the Coles Signal Laboratory, at Fort Monmouth, N. J., figured out scores of variations on that basic pattern. Early systems with bulky external shields barred interference only up to 40 megacycles. Research has now progressed to simpler, integrally shielded and suppressed equipment that promises interference-free communications clear up to 4,000 megacycles—and also makes ignition systems waterproof.

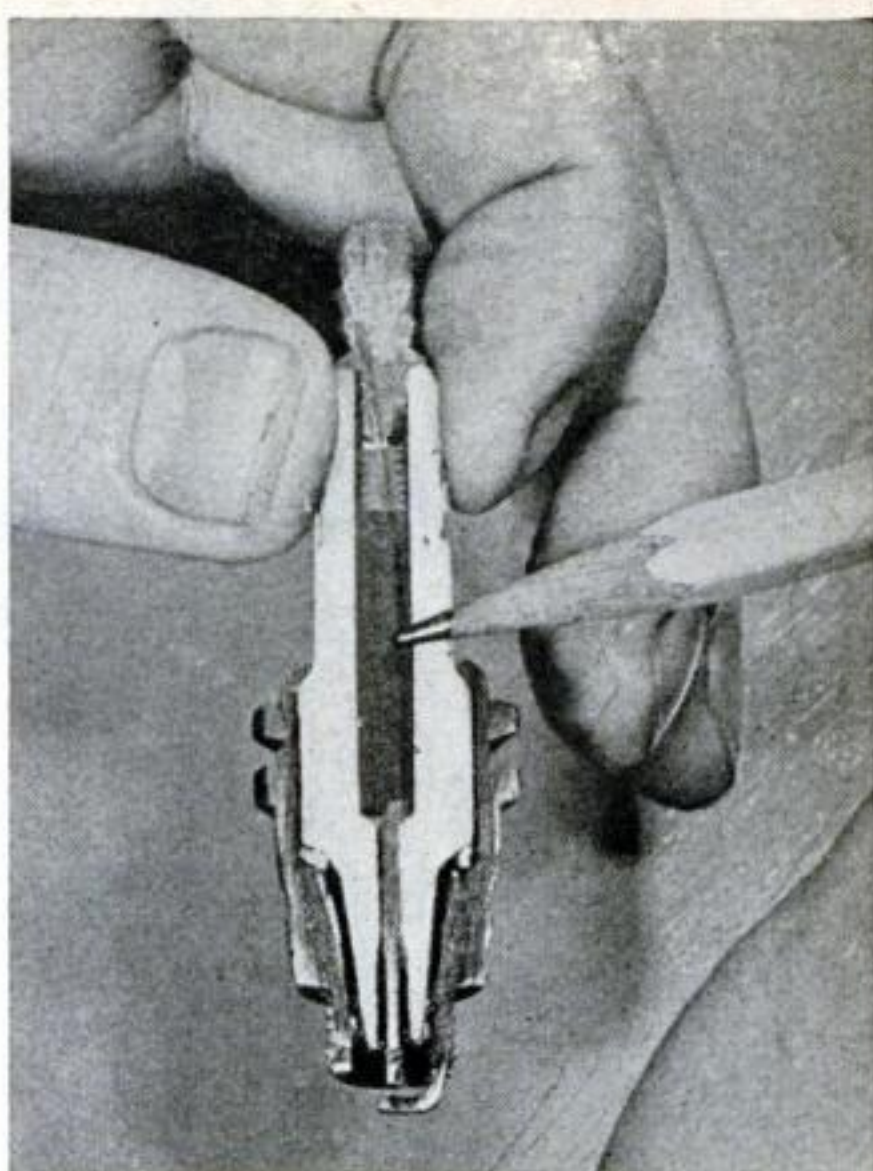
By putting the program on a mass-production basis, military experts hurdled the biggest barrier to getting rid of ignition static—the fact that thirty-odd million U. S. cars have to be “suppressed.”

Now the American auto industry has taken over, and cars are being built to a set of anti-interference standards worked out by radio makers and the Society of Automotive Engineers. Accessory makers are also providing war-developed devices to help the program.

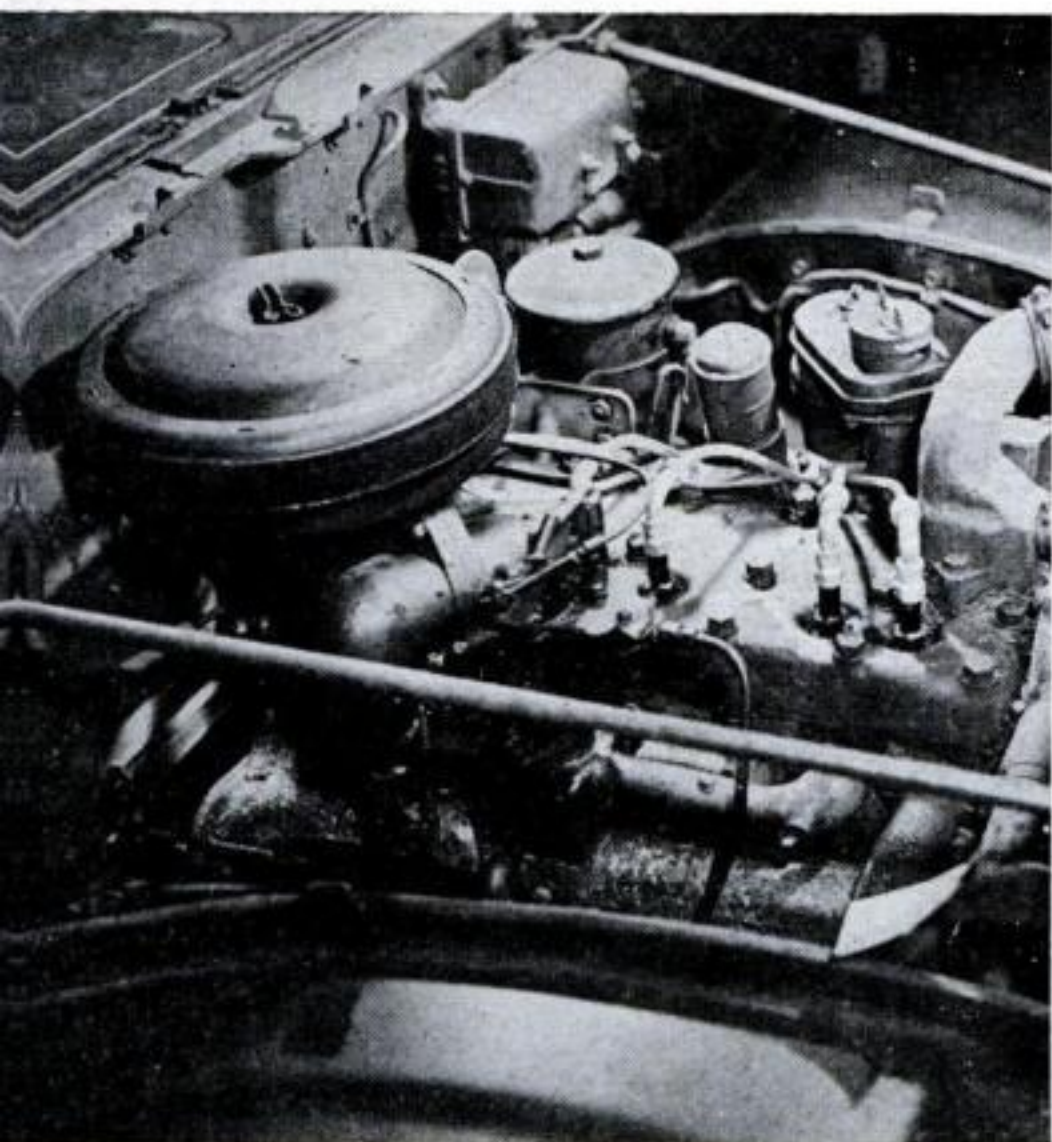
As millions of prewar cars go off to junkyards, radio reception will be freed of one source of man-made static. Short-wave operators will say good-bye to a lot of the “garbage” that has plagued them for years. And owners of television sets won't have to fight shy of highways or set up sky-high antennas to avoid spots before their eyes.



Three steps in Signal Corps' program show progress from separate resistor-suppressor cap (on left) through bulky external shield (center), to specially designed, waterproof spark plug with built-in shield and suppressor (right).



Plugs that suppress themselves are now ready for U. S. motorists. Resistor, indicated by pencil point, seals in noisy impulses. According to manufacturers, it also lengthens plug's life and improves its performance.

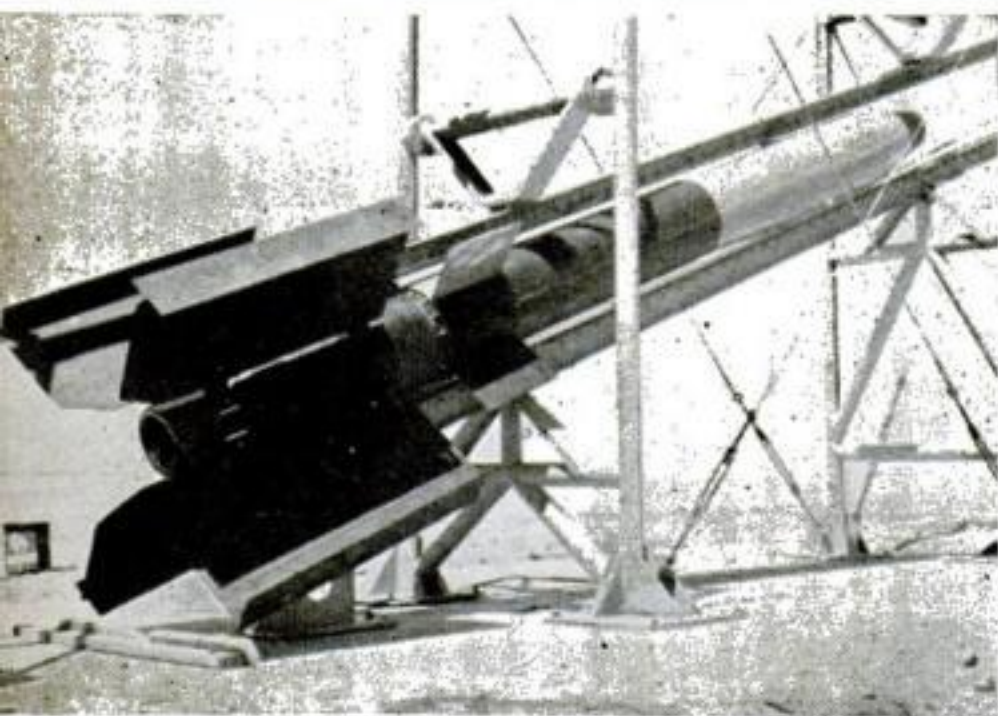
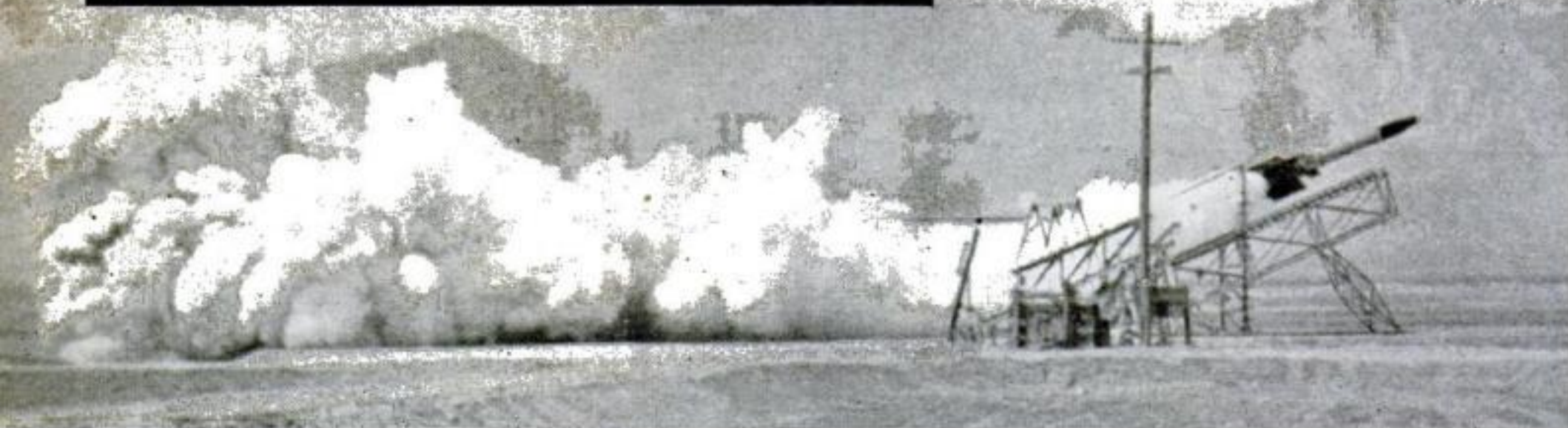


Full shielding on plugs and cables of an Army truck illustrates care necessary to block interference at extremely high frequencies. Distributor and coil are also shielded; chassis parts are bonded together; generator and voltage regulator are grounded through capacitors.



A radio-noise detector, this compact test set was developed to check suppression devices on equipment purchased by the Army. Measuring impulse noise from .15 to 40 megacycles, it will also enable repair depots to spot and eliminate interference from older-type equipment.

What's New in Aviation



Biggest Ramjet Goes Up. Rocketing far above the speed of sound, the biggest "flying stovepipe" ever flown has been successfully tested at the U. S. Naval Ordnance Test Station at Inyokern, Calif. Power for the ramjet's take-off (above) was provided by the big-finned booster rocket shown at left, which drove the ramjet to its operating speed (several hundred miles an hour), then dropped off. The ramjet continued its flight under its own power, which is 25 times as great, pound for pound of engine weight, as the best reciprocating aircraft power plant in use today.



For Happier Landings. To cut down landing-gear mishaps, Lockheed devised this hydraulic drag strut, shown in the wheel well of a Constellation. It lets main wheels move six inches to the rear as they touch down, lessening landing shocks.

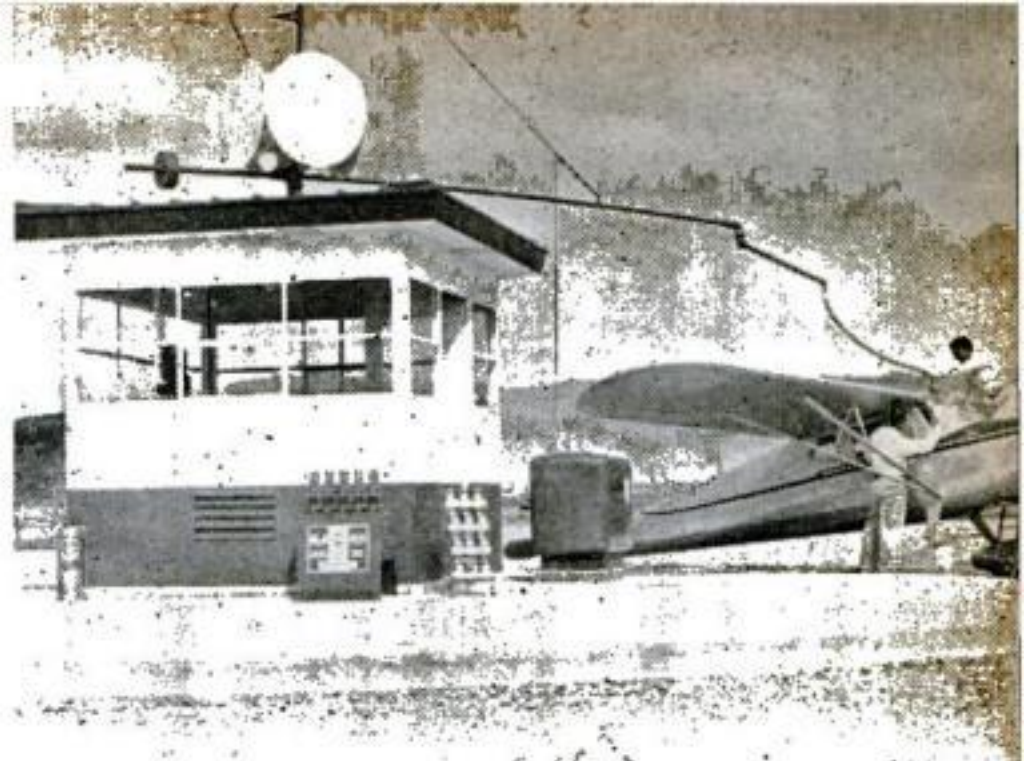


More Power to Them. This 800-ampere power truck is one of 40 mobile generators being put in service by United Airlines. Far huskier than previous models, they are required for ground operation of equipment in the new four-engine planes.



Seaplane Can Carry Own Dock.

Nine inflatable nylon float sections and a hinged plywood deck add up to a floating dock (above) that can be stowed aboard Navy patrol bombers for use wherever no other servicing facilities exist. Although it weighs about 5,600 pounds, the dock can be put together or taken apart on the water.



Gas Station Makes the Rounds.

To speed servicing of light planes, Napa County (Calif.) Airport uses this merry-go-round gas station. Overhead line carries gas anywhere around the circular, 40-foot apron, large enough for five planes at a time. Station was developed by an engineer of the Standard Oil Co. of California.

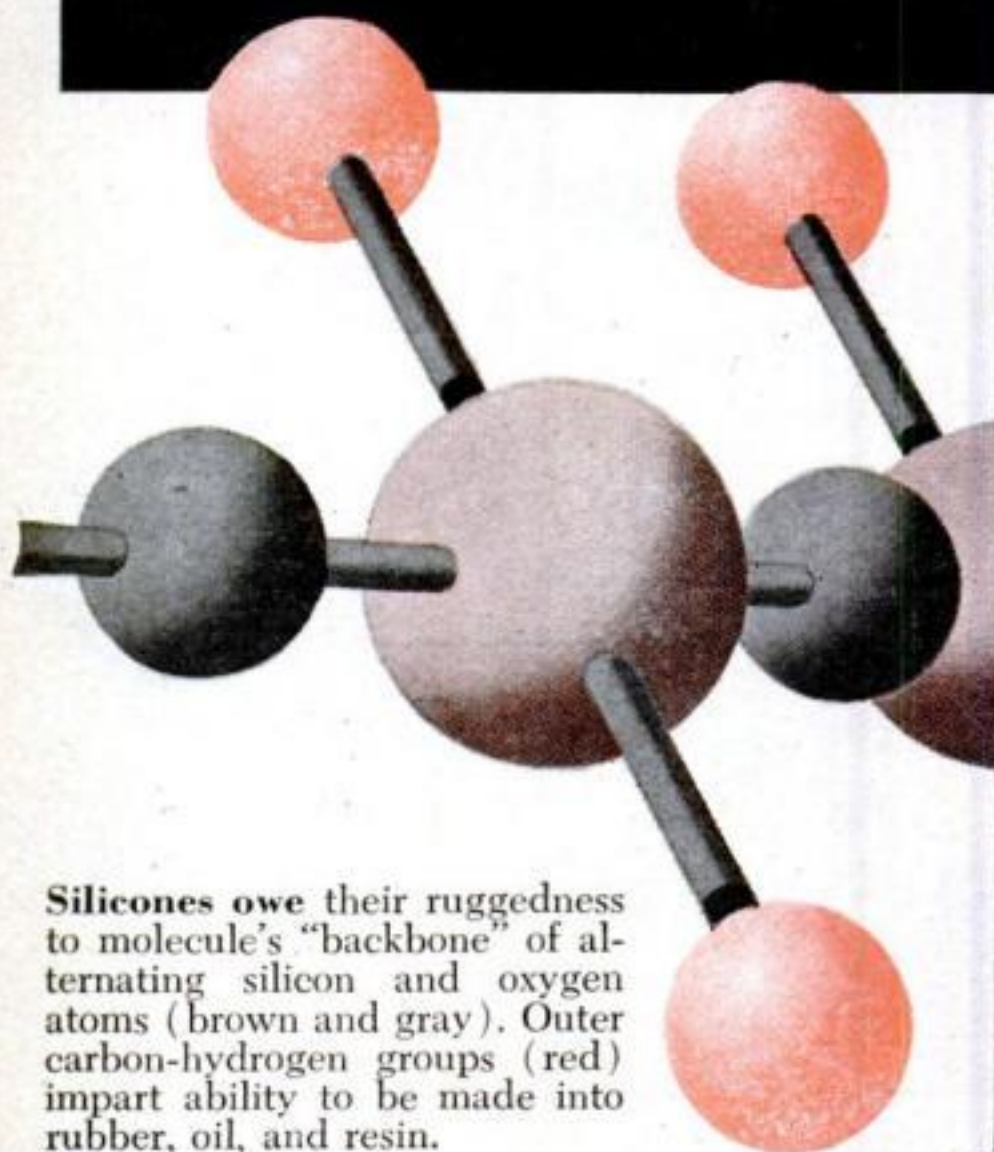
'Copter Flies Itself. With nothing but sandbags for a pilot, an experimental helicopter holds itself just clear of the ground—the first time, according to United Helicopters, Inc., that such a craft has hov-

ered without some means of control. The trick was made possible by the stabilizing control rotor used in the same company's Hiller 360 'copter, designed to permit "no-hands" piloting (PS, Feb. '48, p. 125).





Deluge of water cascades off fabric given Dri-Film treatment, which doesn't alter appearance or "feel" of cloth. In test, GE experimenters successfully applied the same treatment to a suit of clothes. PS photo by W. W. Morris.



Silicones owe their ruggedness to molecule's "backbone" of alternating silicon and oxygen atoms (brown and gray). Outer carbon-hydrogen groups (red) impart ability to be made into rubber, oil, and resin.



How You'll Use The New Silicones

Hybrid chemicals that helped win the war now work wonders for golfers and housewives, fliers and motorists.

By Dr. Dallas T. Hurd

Research Laboratory, General Electric Company
and Alden P. Armagnac

A WHOLE new family of synthetic chemicals, destined to make everyday life more pleasant and comfortable, is now making its debut before the general public. Called the silicones, these ultramodern products can help motorists, sportsmen, and plain John Jones.

Tissues impregnated with one of the new silicone chemicals come in a handy pack for polishing eyeglasses. They leave a transparent, invisible film upon the glass that keeps it magically free of dust and grease.

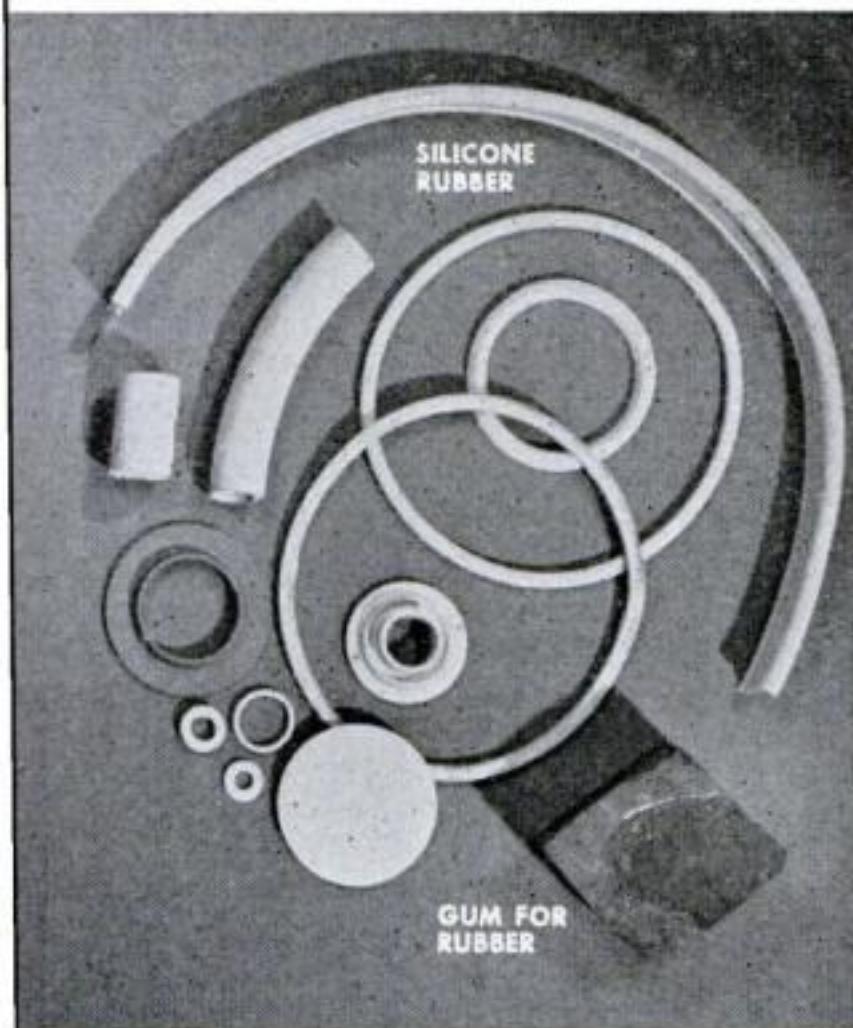
Golf balls whose cores contain a pellet of another silicone compound have just been placed on the market by a leading maker, the U. S. Rubber Company. Said to give greater distance and to have improved "click" and "feel," they take advantage of the exceptionally high elasticity of "bouncing putty," a laboratory curiosity for which

no use was known until recently. A ball of this white or pinkish substance bounces like rubber, yet can be stretched like taffy, and flattens out like a pancake if left standing on a table.

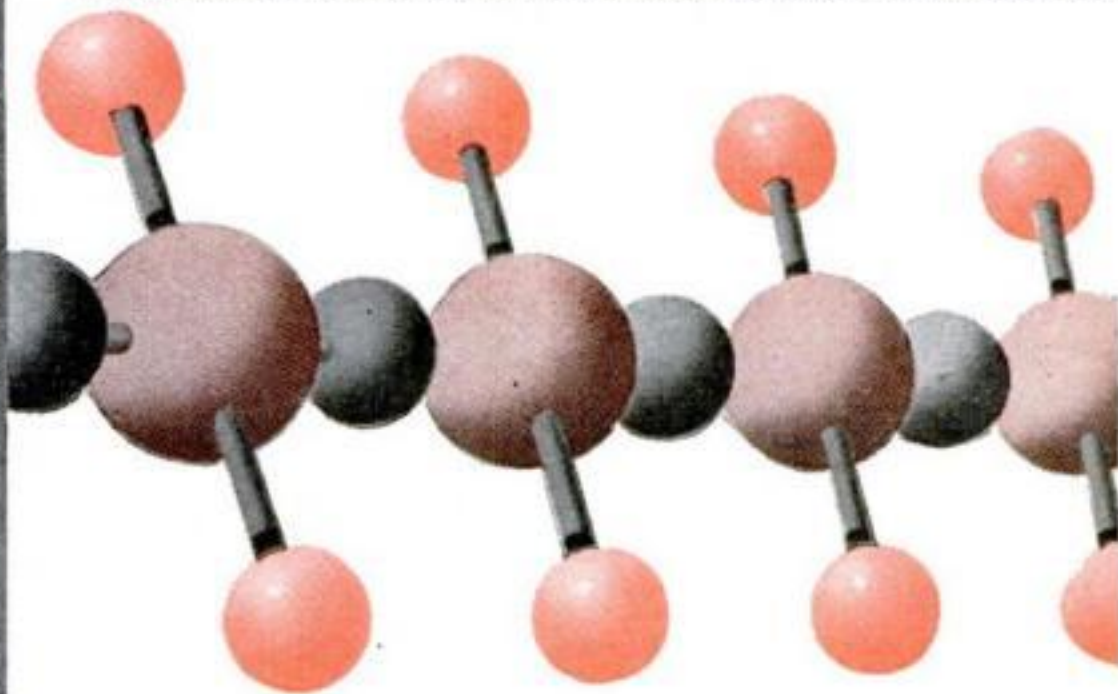
Bouncing putty's slow-flowing property was applied not long ago (PS, March '48, p. 109) to check any quivering motion of small coil springs embedded in it, in tiny attachments for furniture legs that keep tables and dressers from wobbling on an uneven floor.

Fishing line now is treated with a related compound to make it shed water, keep dry, and last longer. Dry flies for fishermen undergo the same process to make them more realistic.

An oil-like fluid of the silicone family that undergoes remarkably little change in viscosity while the thermometer goes from one extreme to the other serves motorists in a radically new type of vibration damper for the crankshaft of an automobile engine. This innovation is the product of the Houdaille-Hershey Corporation and has been adopted, in some of the latest production models, by Ford, Lincoln, Packard, and Mack International. ➡



Examples of GE silicone products and applications, at left, include "lifetime" paints now under development, all-temperature lubricating oil used in motor and timer shown, bouncing putty, mold-release emulsion, Dri-Film[®] water repellent, aircraft transformer with silicone-varnish insulation, and rubber that resists heat and cold.



Silicones can be made into rubber, oil, grease, resin, and paint. They are chemical hybrids, made from sand, coke, salt, and petroleum, and they exhibit all the fascinating possibilities that spring from cross-breeding in the other natural kingdoms. They form a man-made link between the "inorganic" mineral compounds of the rocks, earth, and sand, and the "organic" carbon-containing compounds, many of which are commonly associated with vegetable and animal life. Sand is one of the principal raw materials of a silicone. Therefore the skeleton of a silicone molecule consists of the elements of which sand is made, alternating atoms of silicon and oxygen. It is this same silicone-oxygen "backbone" that gives natural silicate minerals, such as asbestos and mica, their heatproof qualities.

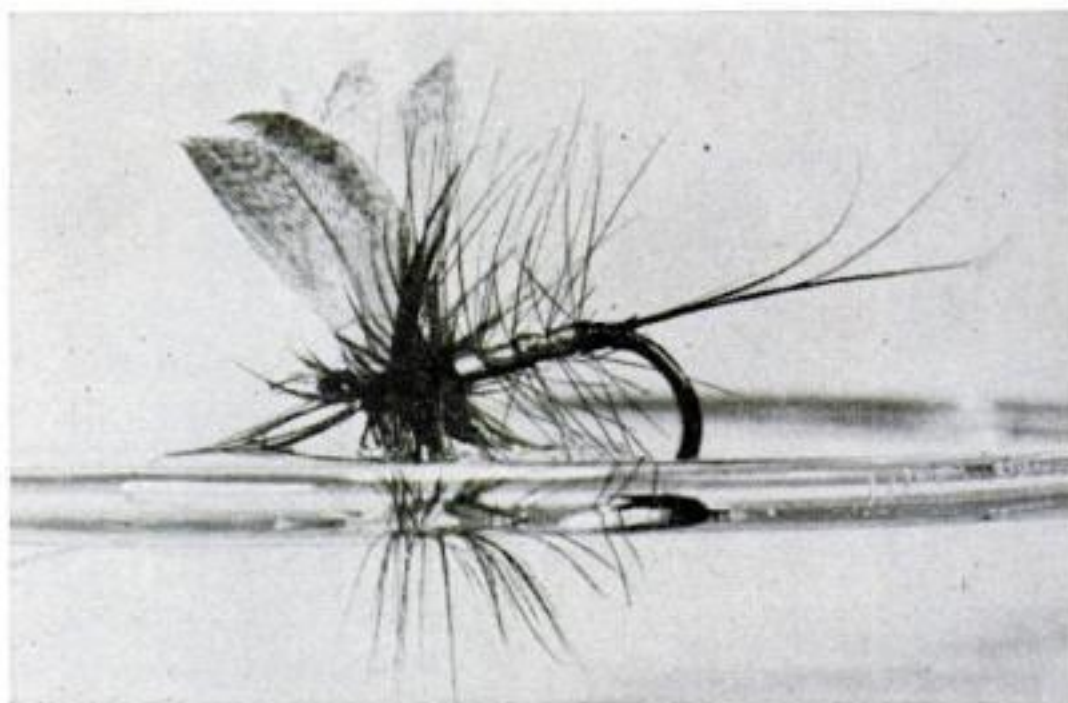
Outwardly, silicone molecules resemble those of hydrocarbons — hydrogen-carbon compounds, such as those of petroleum, which are built up on a skeleton composed of a row of carbon atoms. The silicones thus combine such desirable "inorganic" properties as resistance to heat with the characteristic ability of certain "organic" materials to be formed into rubber and plastics.

First Used in World War II

Long known in the laboratory, silicones first attracted attention during the last war. For lack of a heat-resistant material that would make a resilient gasket, the lenses of searchlights on Navy vessels were often shattered by the concussion of their heavy guns. Gaskets of silicone rubber, produced synthetically for the purpose by General Electric experts, solved the problem. The heat-resistant gaskets filled another vital need in superchargers for B-29 Superfortresses. Until the war ended, military uses monopolized the entire production of the new rubber and other silicone chemicals.

Since then, many of the most useful silicone products developed by the two leaders in the field, the General Electric Company and the Dow Corning Corporation, have been made available commercially. Because they are still relatively high-priced, industrial applications, where their properties are valuable enough to offset their cost, have preceded more general uses.

Supercharged Diesel-electric locomotives and powerful new radial motors for aircraft now make use of the heat-resistant gaskets of silicone rubber. De-icing equipment for plane wings, which uses hot dry air, may



Fisherman's dry fly will always stay dry after a single 30-second dip in new water-repellent silicone dressing supplied for purpose, and eight hours' drying. Compound is a colorless liquid.

prove another useful place for the new material. Besides resisting heat, silicone rubber also remains flexible at temperatures so low as to make ordinary rubber stiff and brittle.

Silicone oils are water-white liquids, remarkable for the exceedingly small extent to which temperature changes affect them. A drop in temperature from 100° F. to zero increases the thickness or viscosity of typical petroleum oil 110 times; of a silicone oil, only four times. Functioning perfectly in heat or cold, silicone oils lubricate electric motors exposed to extremes of temperature, and serve in hydraulic airplane-control systems. A new type of landing gear for aircraft, developed in Great Britain, derives its spring action from another extraordinary property of silicone oil — its "give." Compared to water and most liquids, it is highly compressible.

Quite possibly the last tire you bought for your car was made with the help of silicone oil. Mixed with water, it forms an emulsion now widely used by tire makers as a "mold-release agent." In molding a tire, an inflated rubber bag forces the casing against an outer mold of steel. The silicone-oil emulsion lubricates both parts of the mold, preventing the tire from sticking to either when it is removed.

Silicone resin approaches the ideal in electrical insulation. Motors using it can run at high temperature without damage. Fire hazard due to overload is eliminated. Small motors and transformers will deliver as much power as much larger and heavier ones formerly did. A standard five-kilowatt airplane transformer that delivers power for



Lively golf ball uses pea-sized pellet of bouncing putty in rubber core (left). Wrapped in rubber thread, core rests in half of balata cover (center). Cover is then vulcanized (right).

landing lights, electrically heated flying suits, and other purposes formerly weighed 110 pounds. Insulated with silicone varnish, the same transformer weighs only 12 pounds.

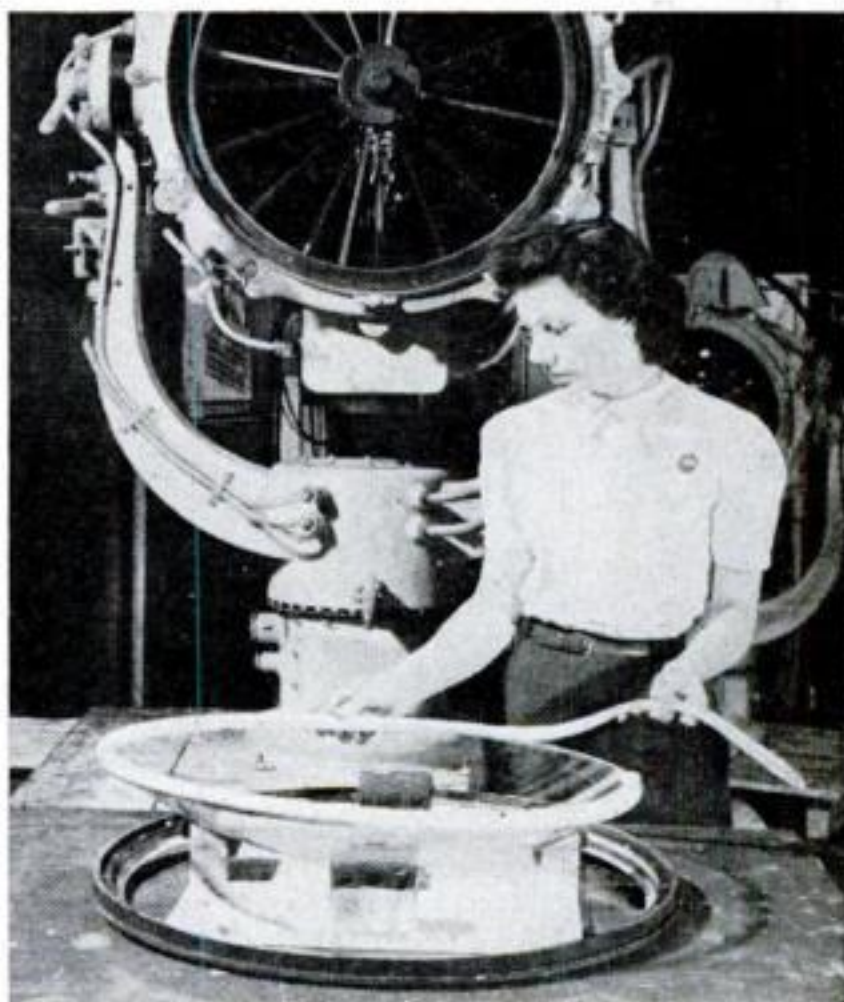
New applications are being discovered almost daily for a moisture repellent—the GE product has been named Dri-Film®—of which one form is a silicone and others are by-products of making silicones. When one of these liquids is applied to ceramics, paper, textiles, plastics, or glass, the surface receives an invisible submicroscopic coating that sheds water completely. One of its first applications was to safeguard the filter paper in gas masks against moisture. Now it repels water from airplane and boat windshields. On insulators and other parts it prevents moisture from interfering with the operation of radio equipment. Fabrics treated with it are unaffected in appearance and “feel.” It does not close their pores, nor is it removed by repeated laundering. Yet, as General Electric experimenters proved in a test, water rolls right off a suit of clothes treated with Dri-Film®. They just don’t get wet.

When larger-scale production and improved methods of manufacture lower the cost of silicones so that the general public can share in more of these developments, the results will be far-reaching.

Hats, suits, and dresses may receive the benefit of Dri-Film® treatment against rain. Silicone insulation may improve household motors, as in washing machines, and produce better toasters, waffle irons, and electric blankets.



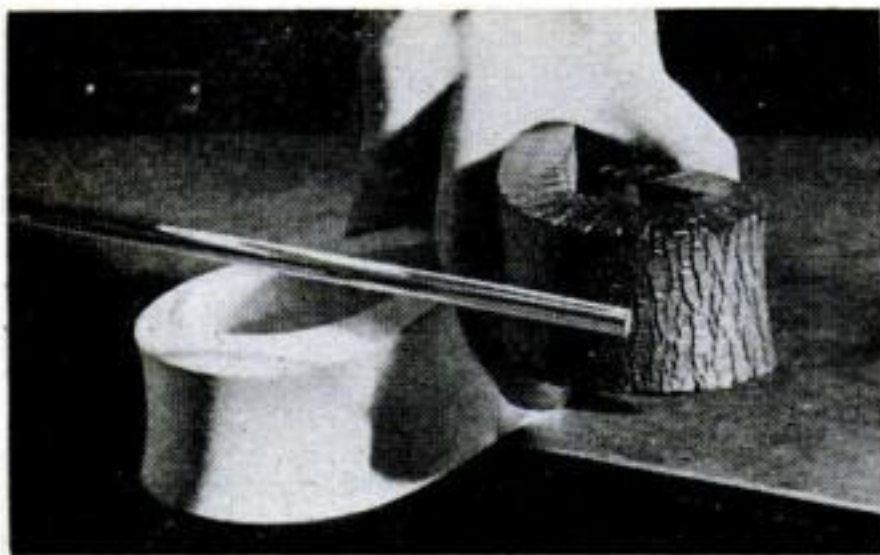
Eyeglasses stay clean longer after being polished with one of these silicone-impregnated tissues. Compound leaves a transparent, invisible film that repels dust, grease, and fingerprints.



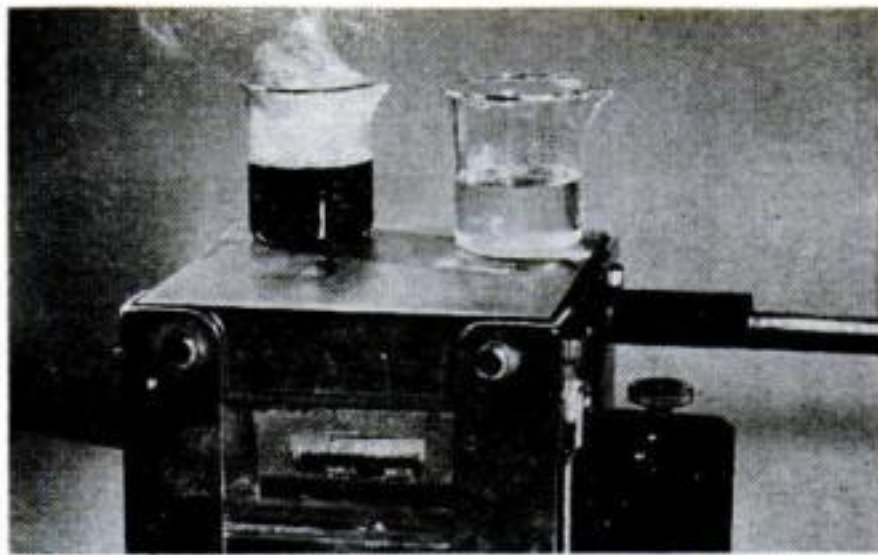
Navy searchlight gets gasket of heat-resisting silicone rubber. Entire output of silicones went to armed forces during World War II. Now they have become available to general public.

Another prospect for the near future, now under active development, may prove one of the most interesting of all. Paints and enamels in all the colors of the rainbow, as well as black and white, will be made from silicone resin combined with suitable pigments and solvents. Baked on steel at high temperature, they will yield virtually indestructible coatings.

Given a coat of the new silicone paint at the factory, your car will have a lifetime finish. Even a delicate pastel shade will



Heat test of 24 hours at 350° F. leaves silicone rubber, left, flexible and unaffected. Sample of natural rubber at right, which underwent same test, deteriorated and cracked as shown.



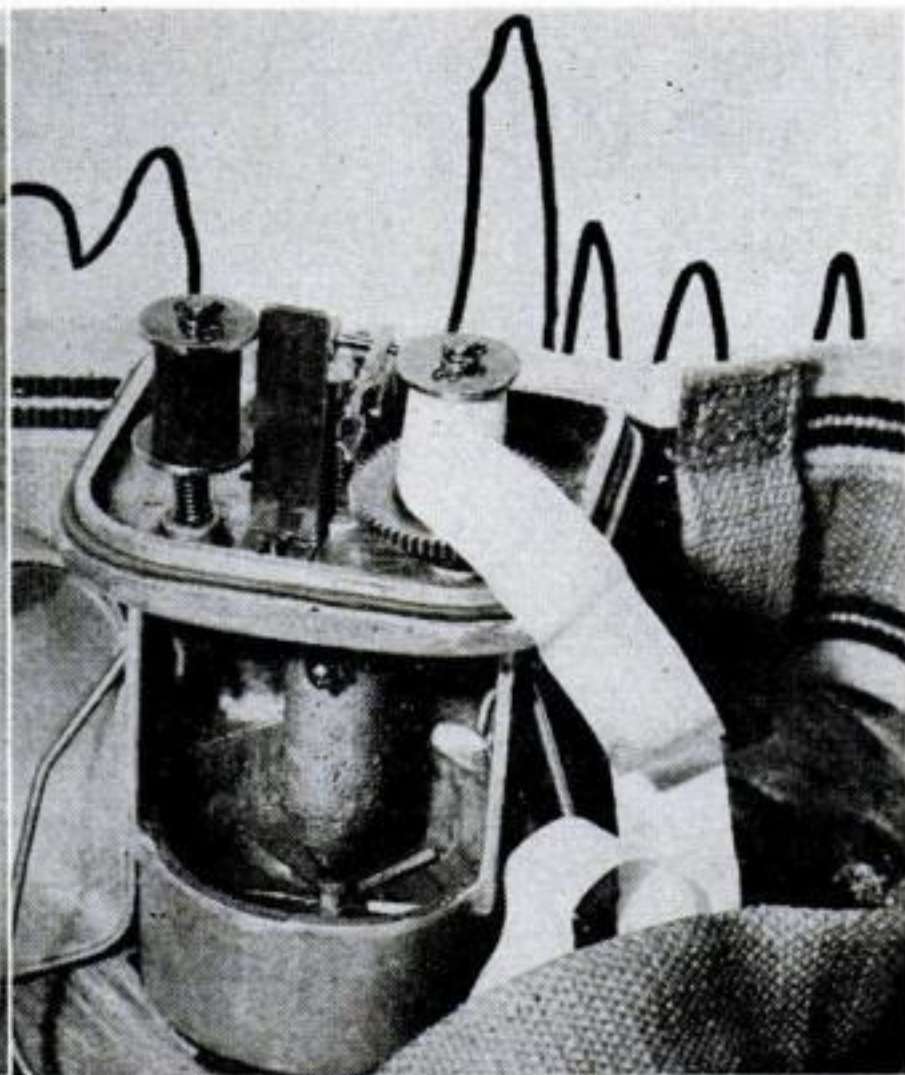
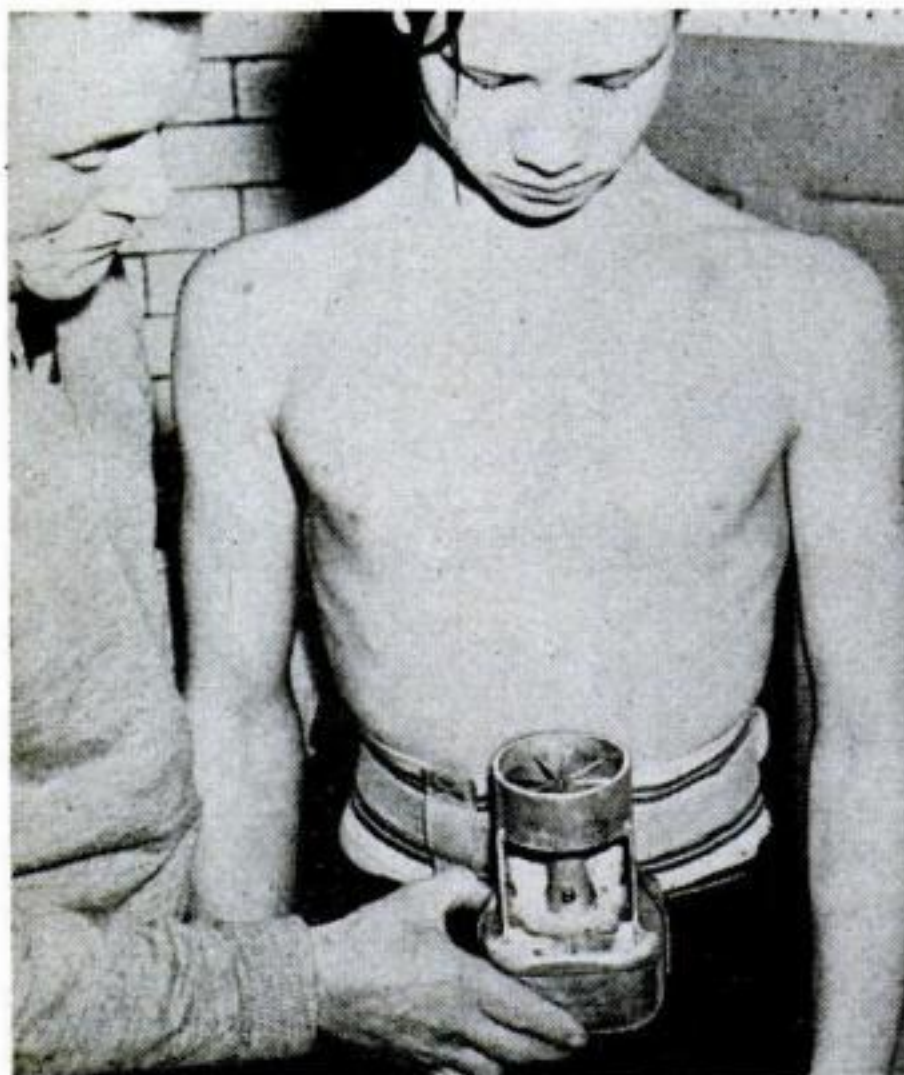
Silicone oil at right resists heat and remains clear in comparative test on hot plate. Petroleum oil, left, is decomposing, as shown by darkening and by smoke rising from liquid.

retain its original color and gloss through year after year of exposure to the sun and elements without fading or suffering damage in any way. Since the car will wear out before the paint job does, a wit remarks, we may look forward to beautiful junk yards.

A similar finish for your kitchen range, refrigerator, and washing machine will be superior in many ways to vitreous enamel. It will not crack or flake, and it will resist

discoloration by hot greases, fruit juices, iodine, and other common sources of household stains. In laboratory tests it has proved impervious to some of the most powerful of corrosive chemicals. It also eliminates waste in manufacture due to rejection of products on which vitreous enamel has chipped, an important consideration that may help to offset its higher cost and expedite its introduction to the public.

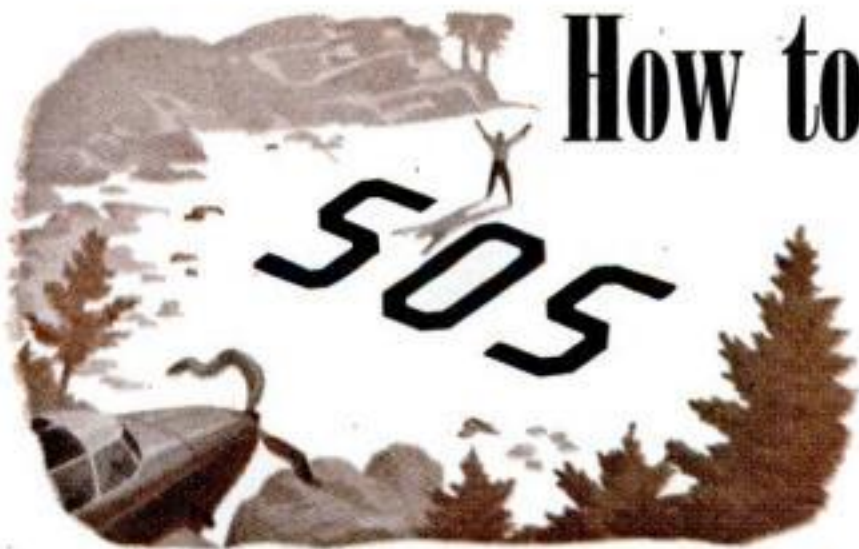
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Meter Aids Swimmers

How well do you swim? Strapped to a bather's waist, the novel recording instrument above graphically tells the story. Rotating as it passes through water, a fanlike

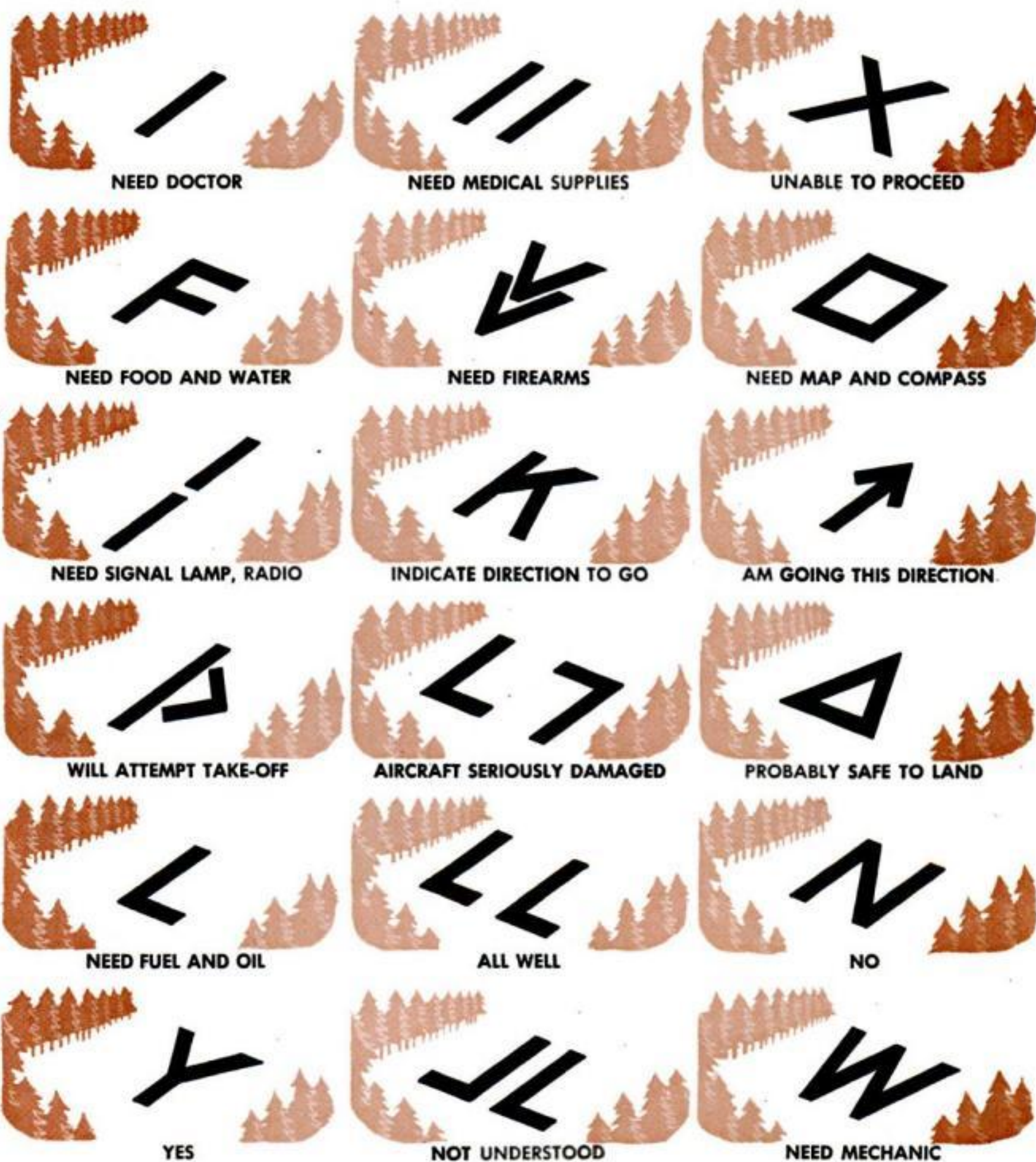
element actuates a pencil that registers the swimmer's speed and the power of his stroke upon a moving paper chart. The device opens as above for inspection of its record, which enables an instructor to detect and correct a novice's faults.



How to Talk to An Airplane

Basic signal is still time-tried SOS. All symbols should be at least 10 feet high, and can be supplemented by flares or smoke to attract notice. Pilot acknowledges by rocking wings.

DOWNED airmen, snowbound trappers, isolated communities—anyone in distress can use these 19 symbols to ask a passing plane for help. They are the official ground-to-air emergency code recently adopted by the Civil Aeronautics Administration. Used in wartime signaling, the symbols can be trampled in snow or laid out with cloth, wood, stones, or anything else that gives a clearly visible color contrast.

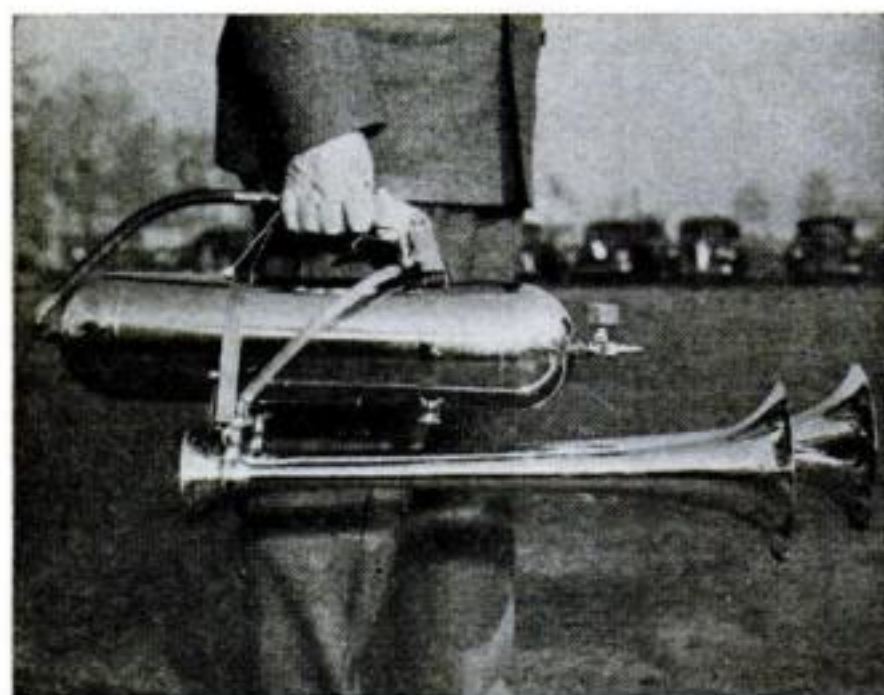




Steel Samples Studied

A FASTER and better method of checking the carbon content of steel has been developed by the Carnegie-Illinois Steel Corp. Three electric furnaces, shown at left, above, each have two silica tubes so that six samples can be tested at the same time. Placed

in the tubes, the samples are subjected to a heat of 2,012° F. Dry oxygen is injected and combines with the hot steel to form carbon dioxide, which is absorbed by the six small bottles seen in middle foreground. The bottles are then weighed in the scale shown at right, giving a basis for calculating carbon content of the samples.



Blow, Pedestrian, Blow

MUCH has been written about careless driving and traffic hazards in Los Angeles, but Hilton Tupman, of that city, has done something about it. Carrying his six-pound pedestrian horn, shown above, he honks his way across streets, warning over-eager motorists that even the lowly foot-traveler has some rights. The tank holds air under pressure of 500 lb. A trigger release under the handle sounds it off, good and loud.



Mask Heats Face

WITH this electric mask you can relax while heat therapy is applied to your face. A product of Progressive Enterprises, of Los Angeles, the mask is intended to relieve sinus pain, and for use where heat is prescribed for head colds, facial neuralgia, and migraine headaches. Made to fit the contours of the face, it weighs only two ounces. Heat is controlled and may be localized to any desired area of the face.



For easy grass cutting, a simple conversion job turns a Bolens garden tractor into a reel-type power mower.

Iron Donkeys

*can save
your back*

Lots of people with a little land are shopping for garden tractors.

Here's what these outdoor machine tools will—and won't—do for you.

By Ladd Haystead

FROM Tom Sawyer to Victory Gardens, back-yard and suburban farming has been a story of burning blisters and screaming sacroiliacs. Yet from around 1915 garden tractors have been in the country, although in a minor way. Now they're moving into the suburbs.

In bygone years, most of them went to commercial truck gardeners, for amateurs found them too expensive and often unsatisfactory. But the sales of garden tractors jumped from an average of about 8,000 a year before the war to a whopping 165,000

estimated in 1947. And this year may see last year's record passed, with householders the big buyers.

No one has come up with a survey showing precisely why this sudden popularity. But for one thing, many of the "bugs" have been ironed out of the motorized hoes. And for another, their usefulness has been widely expanded by the development of new attachments. Moreover, in this day of high prices for everything the first cost of a garden tractor doesn't seem so far out of line when refrigerators and console radios sell for about the same price.

Today, almost every suburban hardware



These are the four basic garden-type tractors, starting with the beginner's baby at the left. Next comes the all-purpose rotary, then the larger straight tractor, and finally the smallest

riding tractor. Power units run from around \$150 to well over \$700; attachments, from a simple spade-type cultivator to a power field mower, run from a few dollars to about \$200.



Bready Garden Tractor



Cunningham with disk



Page Tractor

Most 1½-hp. tractors are similar, but manufacturers try to give extras, such as the lights shown on the Page model above, and the Cunningham's two-gang disk that gives both lateral and swivel adjustment. All types, however, present the same maintenance problems as their big brothers. Working surfaces must be cleaned and rust-proofed before being laid up for the season. The equipment doesn't wear out; it rusts out. Carburetor and gas lines should be drained when the machine is out of use for more than 30 days; otherwise "gum" will form, choking the feed lines. The oil level must be watched closely after the first season, particularly if the machine is operated continuously for several hours. It is easy to consume the entire supply and burn out all the bearings.

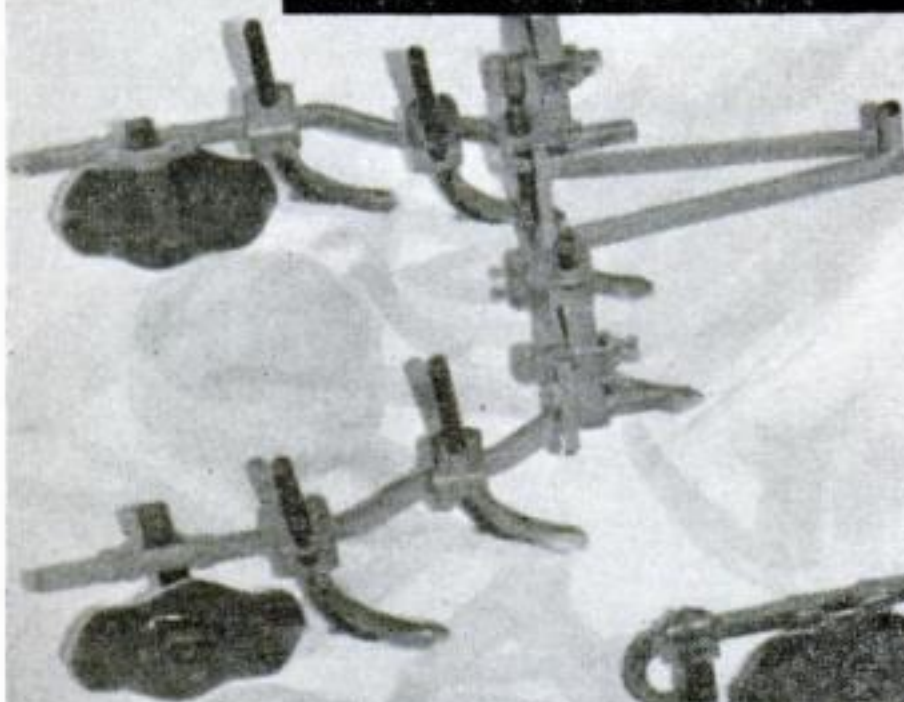
SIX-INCH PLOW . . . \$30.25

The Planet Jr. Garden Tractor and family of tools. The 1½-hp. tractor (center) with a 6-tooth cultivator, is quoted at \$190.50, f.o.b. Philadelphia. The complete line of priced attachments adds \$251.05 to the cost.

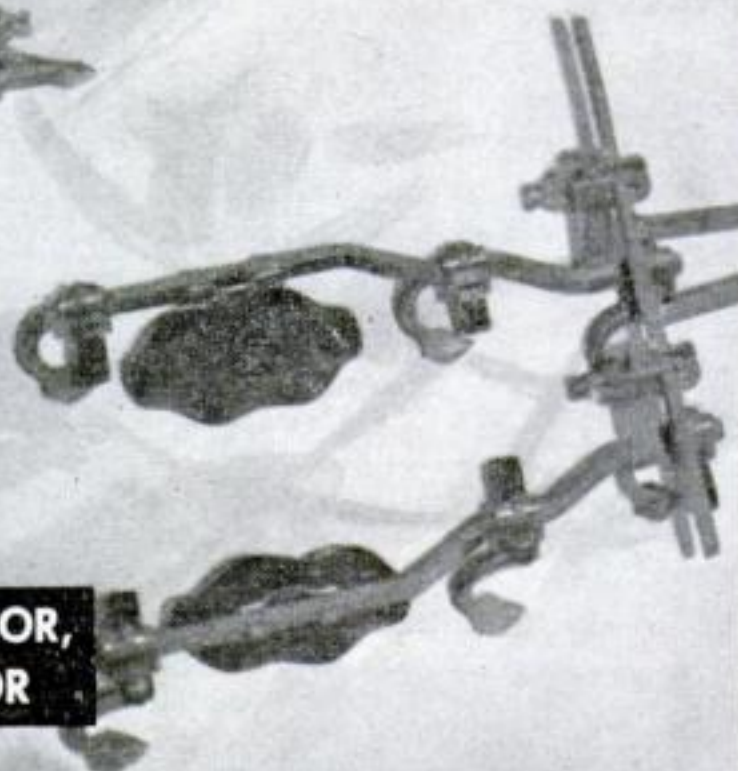



SULKY . . . UNPRICED

HEAVY-DUTY CULTIVATOR . . . \$10.30




STANDARD CULTIVATOR, COMES WITH TRACTOR






TRAILER . . . UNPRICED



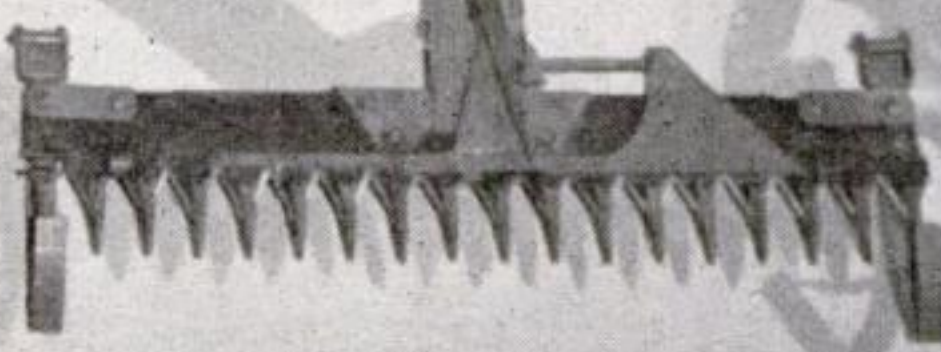
TWO-ROW SEEDER . . . \$64.85



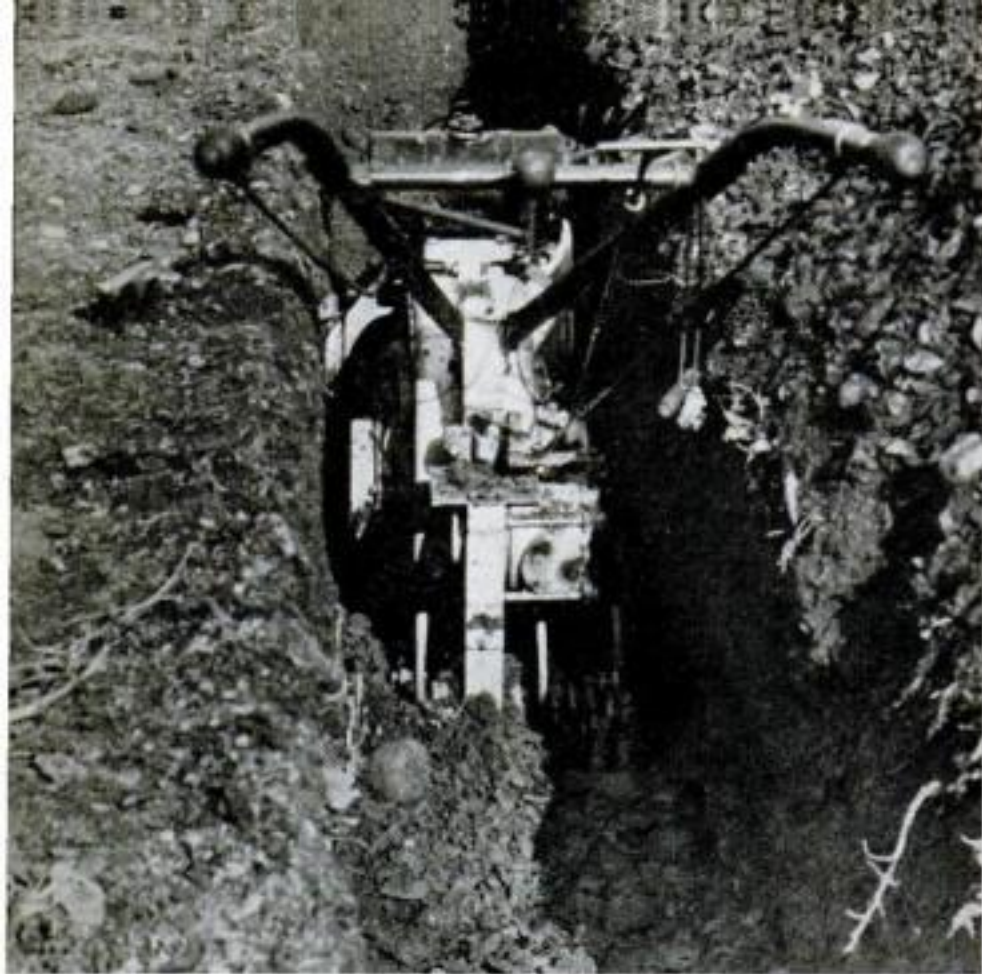
SNOWPLOW . . . \$36.00



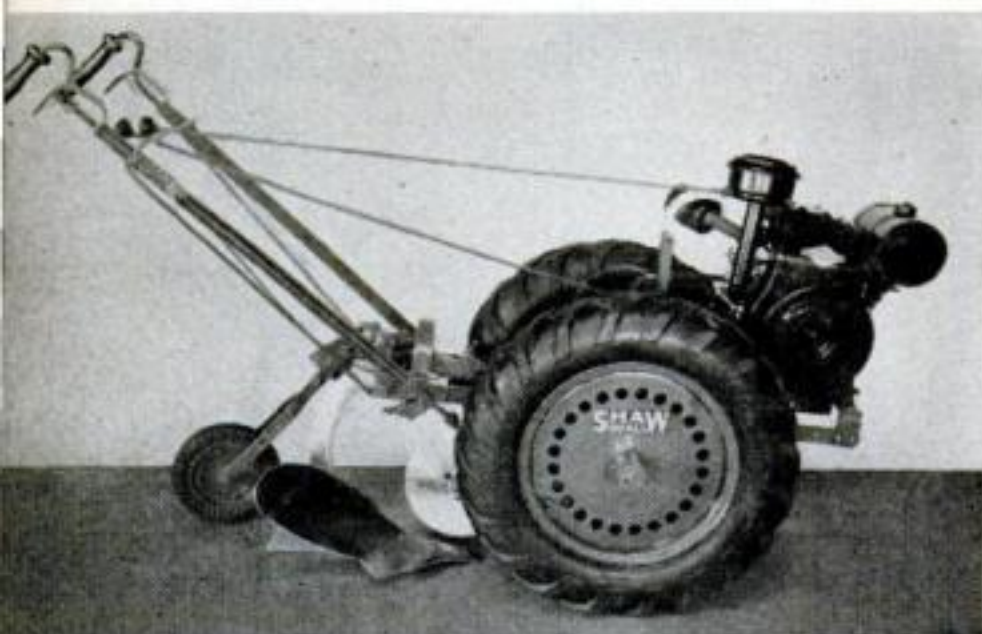
DISK HARROW . . . \$35.80



FIELD MOWER . . . \$73.85



With the Roto-ette[®], a small rotary tiller, you can dig a 3½-foot trench by running the machine over the ground, shoveling out the soil, and then repeating the process. Price is \$360.



The Shaw Du-All[®], equipped with light plow, rolling colter (sharp-edged, rotating steel disk), and rubber following wheel, is popular with both commercial gardeners and suburbanites.

Rotary tillers operate at a comfortable walking speed. The Milwaukee Equipment Co. model, shown below, is similar in capacity and operation to other rotary machines in the field.



Spinning saws of Roto-ette[®] field mower, shown in foreground above, cut weeds and small trees; the revolving dunce caps throw the cut material out at side. Mower attachment: \$160.

and implement store displays the little walking machines and the large family of attachments that go with them. Suburbia's twilight calm everywhere is now punctuated with the *put-put* of a "horse-and-half" at work. And if ingenuity has anything to do with it, the manufacturers intend to hold and expand the new interest by finding even more chores for the willing little iron donkeys to perform.

The story of a potential power gardener goes something like this. In the late winter or early spring, he goes to his seed or hardware store to buy some seeds, rotenone, a new hoe and sickle. When he comes to the two last items, he winces with aching memories. Idly, he tells the clerk that he supposes a garden tractor costs a lot. The clerk assures him this isn't so. Only around \$150, he says, and "it will last you a lifetime."

Plowing Still a Problem

More questions and answers, more memories of blisters and backaches, and a deal is turned. Only the buyer finds that what with cultivators and a hiller the price is around \$200. But when he gets his purchase home, he remembers it will do him little good until his garden plot is plowed. He returns to the store to buy a plow attachment, but the clerk is not so enthusiastic over this idea. Yes, he will sell a tiny seven-inch plow, but actually the gardener will find it better to hire somebody with a larger

machine to do his basic ground preparation.

The gardener then learns that plow sizes, given in widths, by a rough conversion have a ground penetration of about one half their rating. In other words, the seven-inch plow that a small garden tractor will pull only works the soil three to four inches, while the instructions on the seed packet direct a seedbed six to eight inches deep. Somewhat disappointed, the gardener comforts himself with the thought that the hard job is not the seedbed preparation but the long weeks of cultivation, which his unit will do adequately.

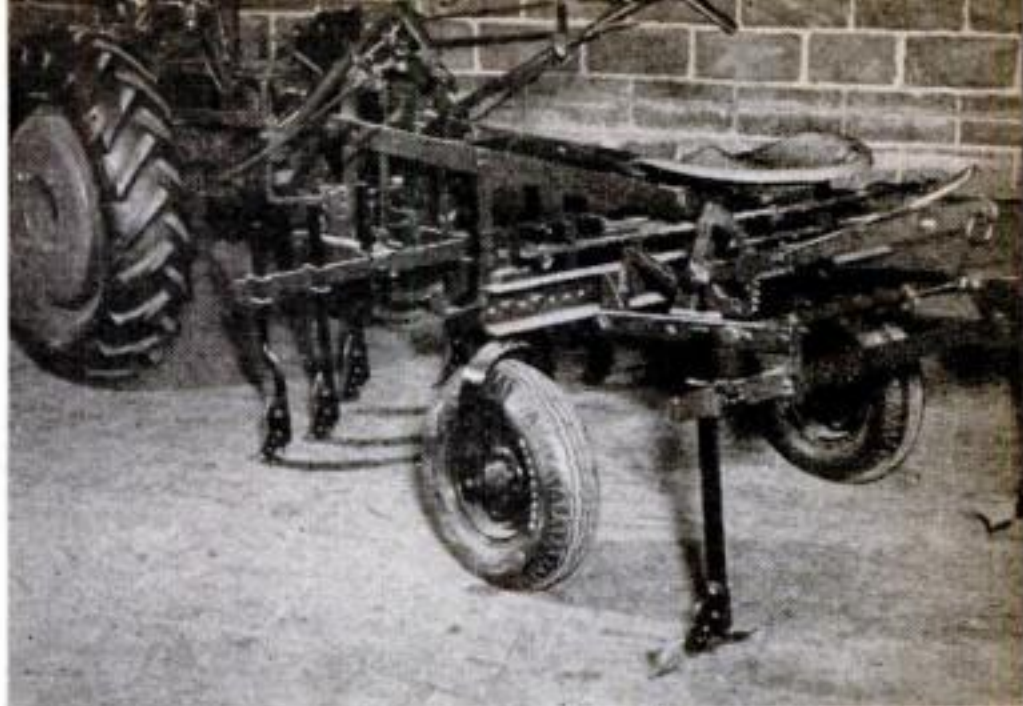
About the time the first cultivation is done, the lawn needs trimming. As long as he has the power unit, why not hitch a mower on it? So he goes back to the store and comes away with either a reel-type or a cutter-bar attachment to take the blisters out of mowing. The ordinary hopper doesn't work so well if the mower is pulled behind. It fills too fast and gets in the operator's way. If the mower is on the front, there is nothing he can do but let the grass fall and rake it afterward.

A Trailer Is Added

Another trip to the store gives our suburbanite a lawn-sweeper attachment that not only will handle the grass but leaves and other trash as well. Disposing of that trash is a headache, but the last time the gardener passed his store they were showing a little trailer that could be hooked onto the power unit. And adding more persuasion to the argument, the trailer had a board across it so that the operator could sit down as he drove around. The trailer joins the growing family in the garage.

Now winter has come and snowplows to attach to the tractor are featured by the store. Another ache to be avoided—and another purchase is made. By this time, the gardener finds the original \$150 investment has rattled past the \$400 mark and shows no sign of stopping. He feels it is time to sit down and see what he has got for his money.

The cultivator works pretty well. Only trouble is, he finds *he* has to keep up with a machine that doesn't get tired. He wishes he could ride, instead of having the thing drag him all over the place. And he feels that if it is to do a good tilling job and keep down cloddiness, he will have to buy a disk come spring. In a catalogue, he has seen a riding-roller attachment that will enable him to sit down while he works the



This 5-hp. Standard Twin convertible riding and walking tractor is rarely listed as a power unit alone. Equipped with sulky and cultivator, cost is around \$600; with tools, \$1,000.



Ariens rotary garden tractor (above) is a competitor of the Roto-ette[®], shown on opposite page. It uses spinning rotor and hooked teeth to plow, disk, and harrow in one operation.



With 42-inch sickle-bar mower attachment, the Gravely 5-hp. tractor works in heavy growth. This machine has plenty of power in terrain where a smaller 1½-hp. job would have trouble.



The Farmall Cub® is International Harvester's garden variety entry. It's a regular farm tractor except for its low 8 hp. With attachments, it will handle all field and garden operations.



Newest of the light tractors is the 6-hp. Jaques-Frazer. With rotary tiller attachment, shown above, it prepares a seedbed in one operation, eliminating disking and harrowing.

lawn, and—he tells himself—his lawn certainly needs rolling. Then, he doesn't like the idea of having to do his seeding the old bending-over way, so he guesses he'd better get a seeding attachment too.

There is still the problem of plowing. And as for snow removal, the 24- or 30-inch snowplow attachment is okay for the front walk when the snow is only a few inches, but it certainly wasn't adequate when the Big Snow came. Nor is it much help in clearing off the 100-foot driveway to the garage. It doesn't have the traction, can't buck the drifts, and there is the problem of what to do with the snow after you have built the pushed-aside snow up a foot or so.

Rotary Tractor Does Many Jobs

The man at the store is helpful. If the gardener wants to plow, the thing for him to do is sell his outfit to a neighbor and get a rotary tractor. Of course, that will cost a bit more—\$400 or \$500, depending on size—but it will plow, disk, and harrow in one operation, besides doing his cultivating and hauling around all the attachments. Or, he can get a larger straight tractor, say three to five horsepower, with a sulky attachment for riding to his jobs. It would prepare seedbeds (in mellow soil—not clays), do better snow removal, saw wood, cultivate two rows at once, and various other jobs. How much would it cost? Oh, somewhere from \$600 to \$1,000.

Well, how about the small riding tractors the equipment companies have been advertising? Possibly the clerk is a little unwilling to discuss this unless his firm stocks the equipment, which most garden-tractor deal-

ers don't. However, the prices run from a low of \$345 to around \$600 f.o.b. factory, and with tools will come to about \$1,000.

It takes quite a bit of garden to justify that much power (7 to 12 hp.). But for the part-time farmer who wants to make his garden a semicommercial project, the small riding tractors have much to recommend them. For one thing, if he is selling commercially he can depreciate the equipment on his taxes.

The long-time headache of the walking tractor manufacturers has been, and still is, overselling by salesmen and over-expectation on the owner's part. The little machines will do most of the things claimed for them, but will not do the job of full-sized tractors. In the horse-and-half range, adequate plowing is out. Nor will saw attachments for this power do a job of bucking heavy hardwood logs, although they may be quite satisfactory on small fruit-tree limbs, cured pine, tamarack, etc. From a gardening standpoint, they leave something to be desired in trash burial, although here the more expensive rotary jobs are quite successful.

The rotary machines work on an entirely different principle from the straight drag-through-the-earth technique of the small-wheeled unit, which is the same as the big farm tractors. In the rotary type, curved teeth mounted on a power-operated rotor dig into the earth several inches, completely chopping and burying the surface trash, and make a row from 9 to 30 inches wide. By going over the worked soil several times, sufficient penetration can be secured. The seedbed is ideal, usually, but in some soils is subject to washing or blowing.



The Farm Imp[®], a stubby, 6-hp. job, can spin around within 5½ ft. A product of the U. S. Tractor and Engineering Co., it is the West Coast's entry in the light riding-tractor class.



The Haney Bull Terrier[®] boasts a 12½-hp. engine. It has three forward speeds, reverse, power take-off, and turns in 7½ feet. A low-price contender, it sells for \$575 at Philadelphia.

Though more expensive, this tool is favored by market gardeners for its high quality and dependability as well as the thorough weed control and the excellent absorptive mulch it gives.

Even as on farm-sized tractors, the catch in the economics of all power garden tools is in the low annual hourly usage if the machine is only to do one or two jobs. The big farm tractors did not begin to reach their wide ownership until many jobs beside plowing and cultivation were found for them.

Advantages of a Riding Tractor

In the same way, the more jobs the small tractors can do (which means more attachments), the more justifiable their ownership becomes. The beginning power gardener, then, should resign himself to an expected expenditure greatly in excess of the cost of the basic unit. Of course, this has one helpful feature: you don't have to buy all the attachments at one time.

However, if the plot to be worked is more than home garden size, if it is suburban acreage or a part-time farm (of which there are an estimated nearly three-quarters of a million now), it would be wise to inquire into the riding 7- to 12-horsepower tractor. In many cases, it and its string of tools will not cost more than the smaller walking-jobs-with-sulky-attached. Its higher power gives greater versatility and a wider range of possible work. Yet it must be noted that for the most part it will not handle a single 14-inch plow, or seven inches of penetration.

The 12-inch bottom is the one usually recommended. Its wider turning radius means that more land must be wasted in

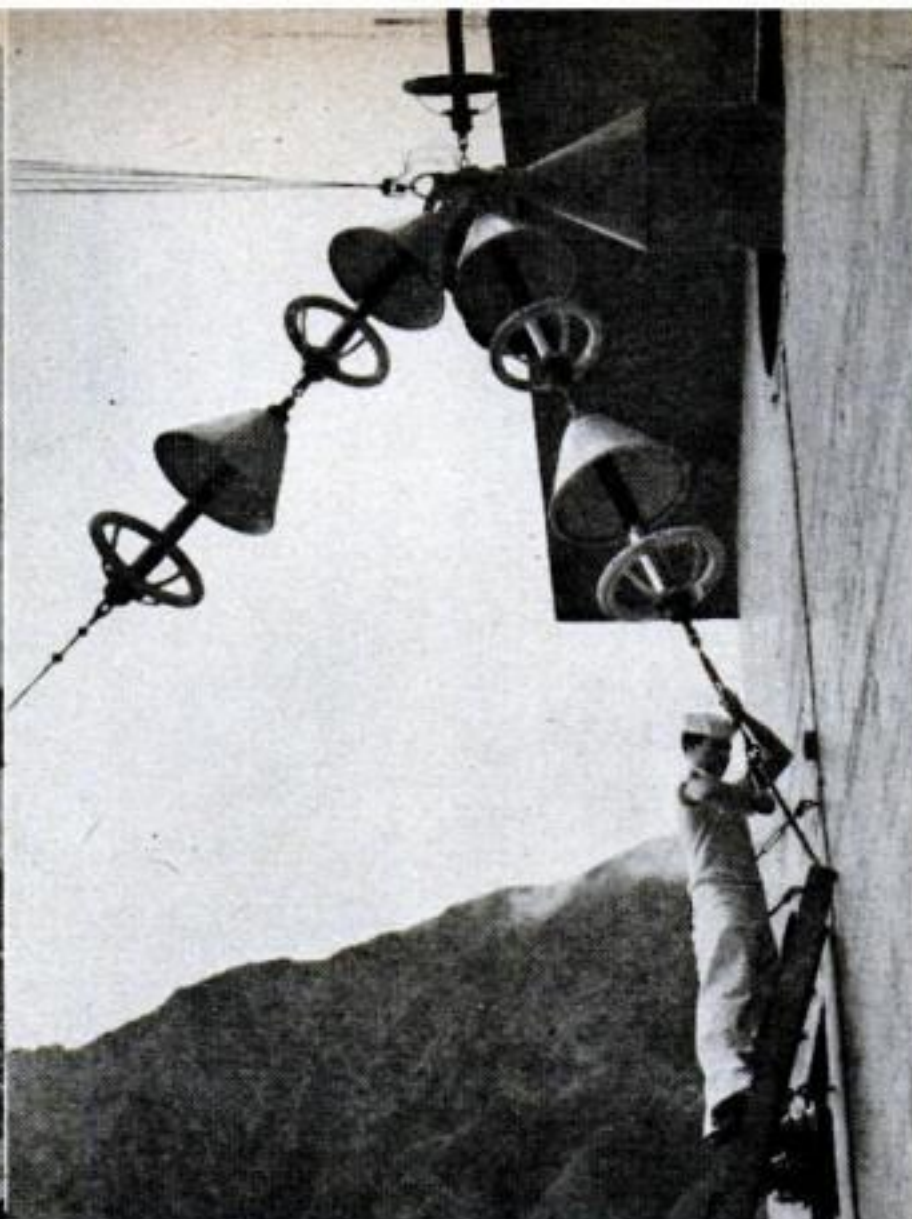
headlands (unusable area at the end of the row), but it does have a reverse. Most walking tractors do not have this feature, although many of them will in the future. This is becoming more important as attachments get heavier, for it is a man-sized job to haul backward several hundred pounds of tractor and attachment when a heavy rock or buried piece of wood comes up in the row.

Although garden tractors have their limitations they are filling a need. And though they may seem expensive at first glance, consider them in relation to a secondhand car. Do you know where a used-car lot is offering anything worth-while for a few hundred dollars?

END



Also handy around the garden is this Holland Sizz-Weeder[®]. A flame weeder, it works on the same principle as its big brother of the South's cotton fields. This garden model sells for \$35.



Aerial Spans Canyon

AN ANTENNA that seems to hang from sky hooks is sending radio messages to Navy submarines in the Pacific. Its five $1\frac{1}{2}$ -mile-long cables are strung across the 2,000-foot-high walls of Hawaii's Haiku Canyon. Giant anchors, inspected weekly (above, left), secure the cables at the edges. The aerial

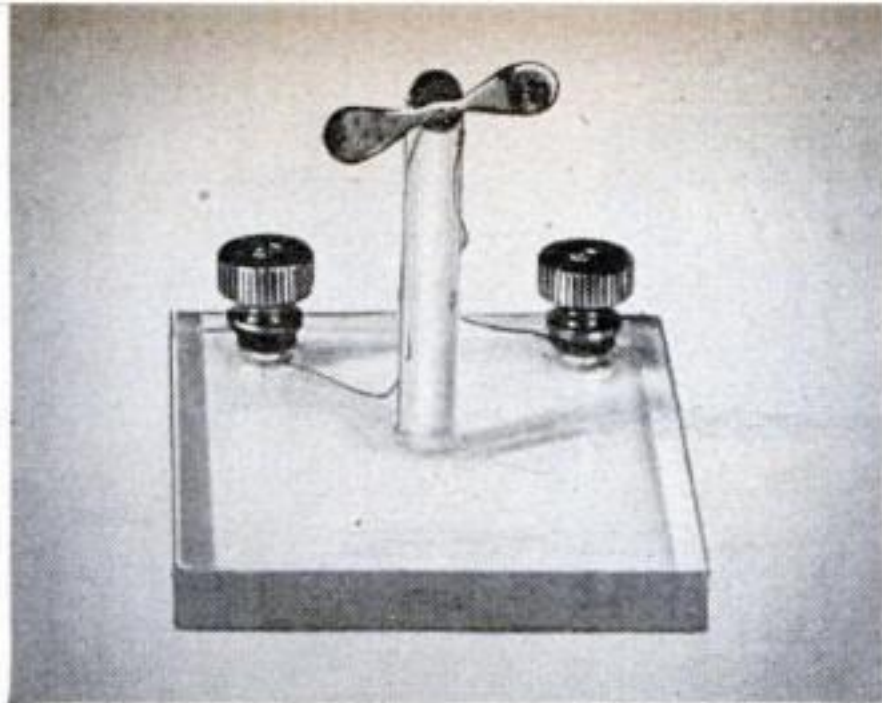
is so high that the lead-in lines, arcing upward from the transmitter on the valley floor (above, right), seem to climb straight into the clouds. The installation has a 200,000-watt alternator transmitter and a 50,000-watt vacuum-tube transmitter, and is one of the Navy's most powerful low-frequency stations. The low frequency can penetrate ocean depths to reach submarines.



Diamonds Speak Up

DIAMONDS are being turned into powerful amplifiers—despite the fact that they do not ordinarily conduct electricity. Physicists at the Bell Telephone Laboratories are bombarding snowflake-size diamond chips with millionth-of-a-second bursts of electrons, and inducing currents in the chips as much as

500 times greater than the original current. Gold-plated on two sides to provide electrical connections, the chips are mounted in ceramic sockets (right) and then tested under bombardment (left). A 60-cycle alternating current is applied to the diamond to cancel out "trapped" electrons that would obstruct the amplified current. The method reveals a new field of electronics research.



Actual size of world's smallest electric motor is shown in the two photographs above. At left, it spins "fan blades," little larger than a fly's wings. Though dwarfed by comparison with



1.40-carat diamond in girl's ring, at right, it runs efficiently at 7,000 revolutions a minute on current from a flashlight dry cell, and demonstrates practicability of compact, new-style design.

Button-Big Motor Runs



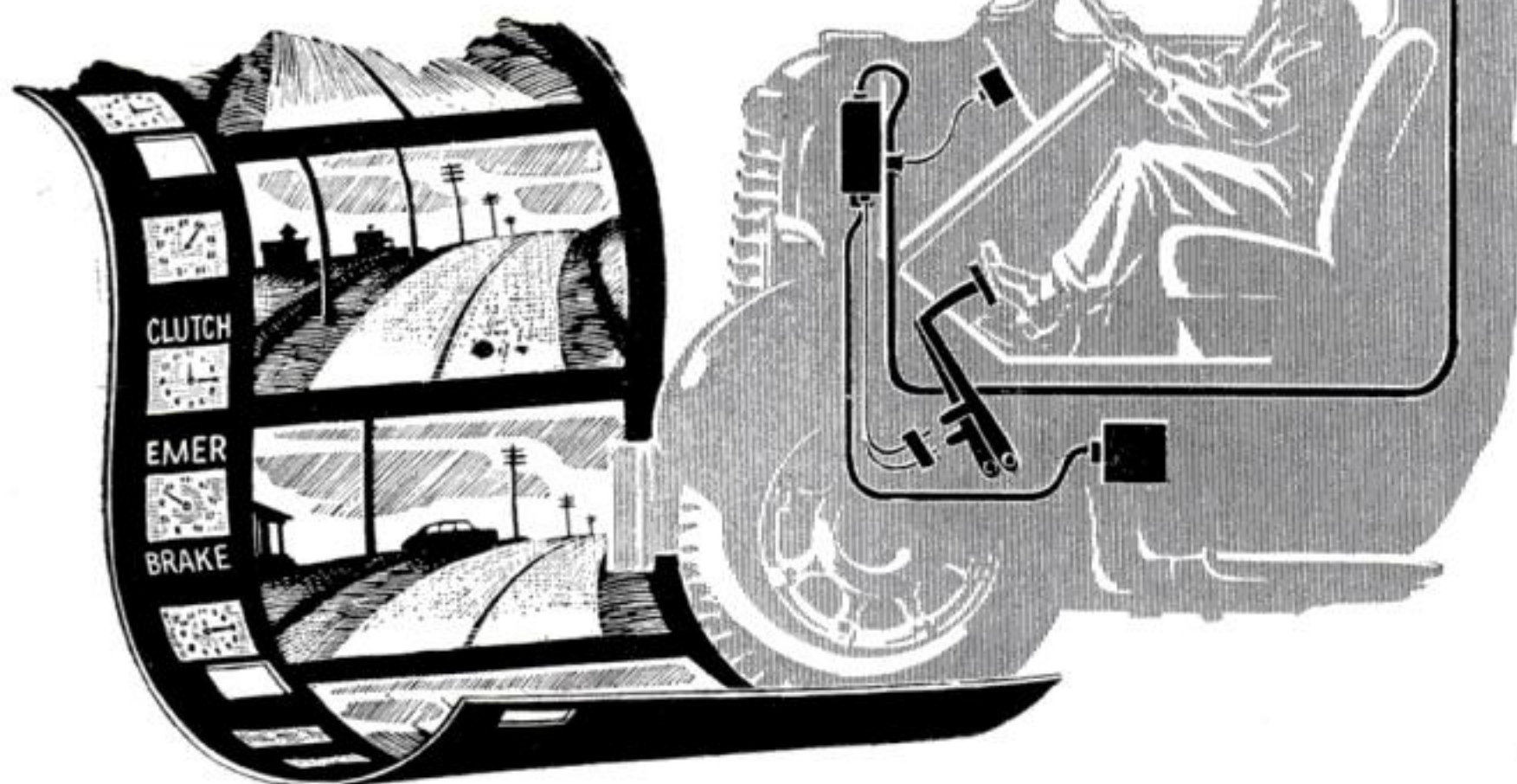
Larger motors of the new design drive models and toys. Model locomotive uses type measuring $9/16$ -inch wide and $7/8$ -inch in diameter. Miniature boat employs the next larger size.

RECENTLY exhibited for the first time in the United States, an electric motor called the smallest in the world measures only $3/16$ of an inch in length and diameter. It runs with high efficiency on $1\frac{1}{2}$ volts at 7,000 r.p.m. This pygmy among power plants, of which half a dozen fit in a thimble, is the most diminutive of a series of four subminiature, direct-current motors applying a design invented by J. V. and J. E. G. Eurich of Lancashire, England. They will be manufactured in this country by the U. S. Instrument Co. of Summit, N. J., under the name of Electrotors®.

The smallest model is a custom-built motor, intended mainly for demonstration purposes but suitable and available for use in highly sensitive scientific instruments. Popular models to be produced in quantity begin with a $3/4$ -ounce motor of $9/16$ -inch width and $7/8$ -inch diameter for modelmakers, and for use in toys and battery-powered electric razors. It runs on 3 to $4\frac{1}{2}$ volts and consumes less power than a flashlight bulb. A motor of $1\frac{1}{2}$ -inch diameter and width may be used in larger models, automatic windshield wipers, movie cameras, and midget air conditioners. A "heavy-duty" motor of twice this size completes the series.

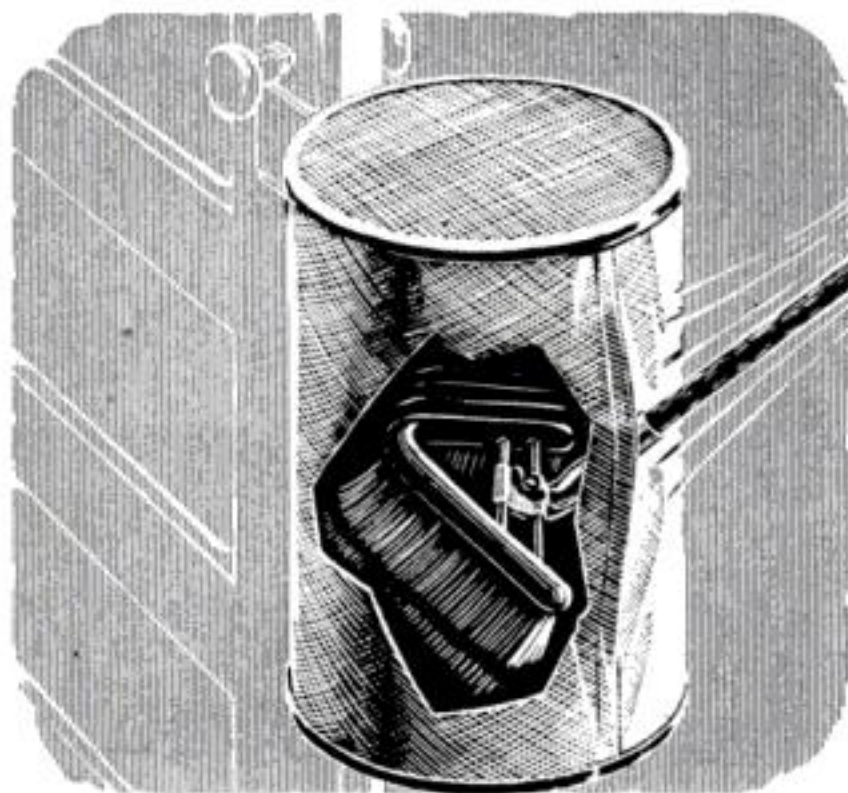
Not scaled-down counterparts of standard types, Electrotors® owe their small dimensions to radical departures in design. A "gap-ring" armature—an electromagnet of horseshoe shape—revolves within a permanent ring magnet, picking up its current from contact points without the use of a commutator. The motors are self-starting and instantaneously reversible.

New Ideas from the Inventors



Camera Records Driving. This device helps tell who's to blame in an auto accident. Such data as time, car's speed, and brake position are relayed to dials behind a camera atop the car. Reflected into the

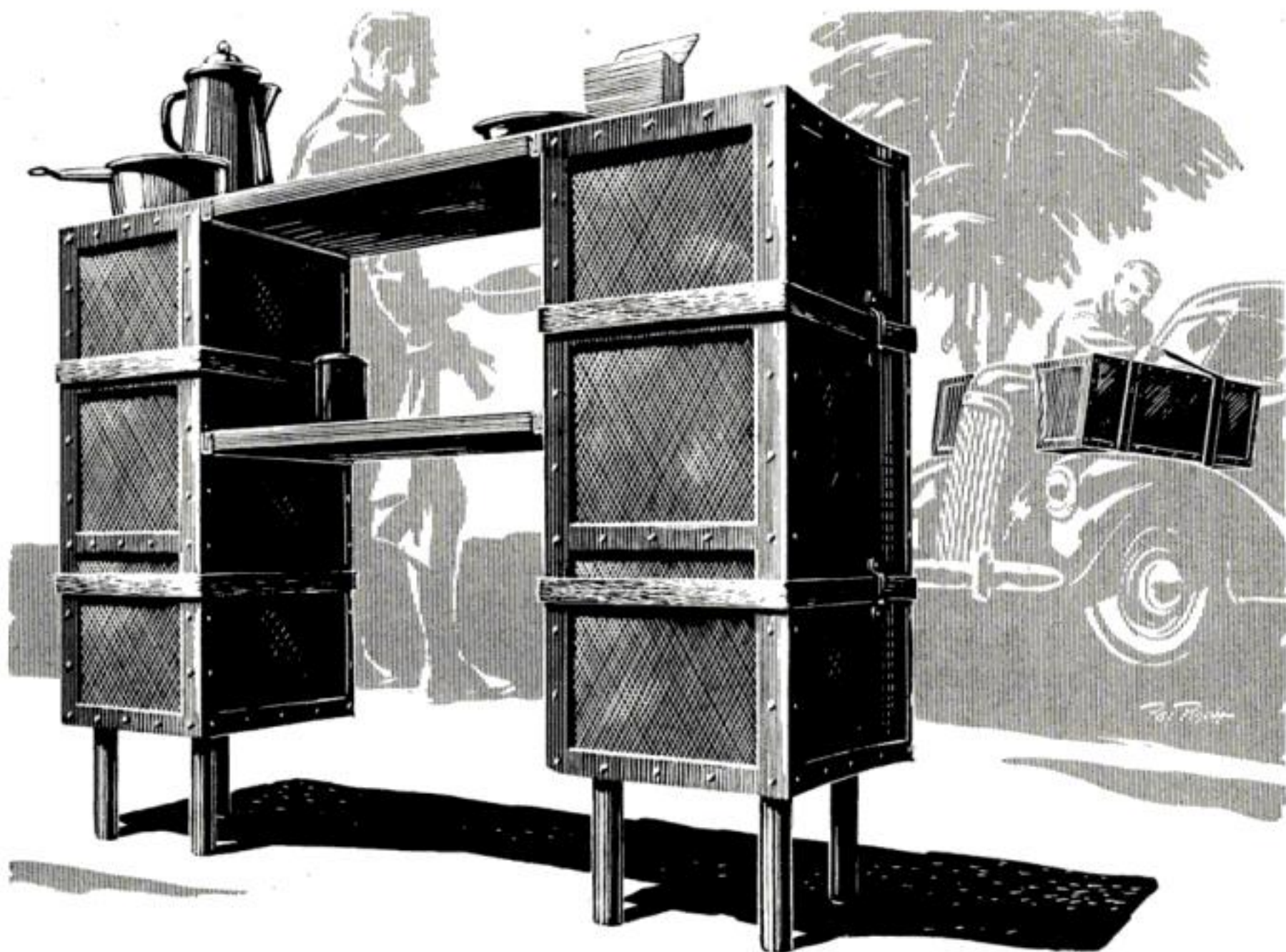
wide-angle lens, these are recorded on film's edge as camera automatically snaps the road every few hundred feet. Inventors are G. Finnegan, of Mountain Lakes, N. J., and H. Durham, of Munsey Park, N. Y.



Dust Can Is Collapsible. You wouldn't have to shake your mop out the window if you had this flexible dust catcher. Invented by John Barkl, of Washington, D. C., it can be carried from room to room and hung from the doorknobs. It is slit to let in the mop, folds flat for easy storage.



Cord Holder Clamps On. To keep your ironing cord out of the way and free of tangles, Charles Borgolte, of Woodside, N. Y., has invented a boomlike arm that holds it high in the air and swings back and forth as you iron. A spring at the pivot point keeps the arm at one side when not in use.



Boxes Become Desk. A pair of crates fit together to make this portable table for use as a camp kitchen or field desk. Curved along one side, the boxes can be packed with supplies and carried on either

side of a car's hood, pack-horse style. In use, they are stood on end and joined by shelves that provide work space. Pipelike legs adjust their height. They were patented by Lester Scott, of Wheatridge, Colo.



Harness Keeps Baby Safe. This bedsheet baby harness for crib or play pen keeps the little one out of trouble when alone. Fastened to the sheet by two straps that cross each other, the baby can roll over or sit up, but not crawl away. It was invented by Charlotte Krogh, of Compton, Calif.



Heels Are Interchangeable. You could quickly replace a worn or broken shoe heel with the detachable one patented by Thomas Gilmour, of Brooklyn. The slotted heel slips on a T-shaped bar on the shoe, and a small latch locks it in place. The device also lets you use various styles of heels.

Machine Probes Your Personality

Are you a square peg in a round crowd? The Interaction Chronograph helps choose the best team for you.

By Herbert Yahraes

PS photos by Hubert Luckett

MID-JULY and the Bears have finally got going . . . Chances bright for the first pennant in years . . . Pitching staff, though, could stand some jacking up . . . So Bull Smith packs off a pretty good relief hurler and plenty of cash to get the phenomenal Kentucky Kid. "With the Kid," he tells the world, "we can't be stopped." Instead, the whole team slumps, drops out of the first division. "The creepers-jeepers that have struck the Bears," reports a *Morning Sun* analyst, "are due directly to the friction between Roaring Bull and his new pitcher; it's got the whole team down. Too bad the Bull didn't find out beforehand that the Kid was one man he couldn't browbeat."

With a recently perfected personality machine, the Bull could have done just that. For the machine tells, almost automatically, whether or not one person is likely to get along with another. Beyond that, it measures the qualities of personality necessary for certain work and sizes up, with uncanny accuracy, foremen and other bosses.

It has not yet been used to prevent or diagnose the personality troubles of a baseball team—but it could be. Furthermore, it could help a president select a smooth-working cabinet and enable a Leap Year girl to pick the right man.

The machine was devised by Eliot D. Chapple, a Harvard Ph.D. trained in anthropology—the science of man—and some equally learned associates. Early work on it was financed in part by the War Production Board. Some of its results have been reported in half-a-dozen first-rank scholarly

journals. It has been tried on several thousand persons—in industry, a big department store, and a hospital.

Now Chapple has branched into organization engineering, putting on a business basis the scientific know-how of relating people to each other in terms of the job. His personality quizzer is available to any firm that wants to bolster output and morale and fit square pegs into square holes.

Chapple's invention is precisely but rather alarmingly named the Interaction Chronograph, a title somewhat less complex than the machine itself, which is a crinkled gray metal cabinet almost as long as a desk, filled with an orderly jumble of chains, cogs, pulleys, and electric wires.

Its general principle becomes clear when you keep in mind that the whole thing started 10 years ago with just a stop watch and an idea—that perhaps you could tell how a man would get along with others if you *timed* his contacts.

Measuring Human Relations

Industry is filled with skilled interviewers of personnel, but an applicant may know all the answers and still not be fitted for the job. He may say the right things but fail to do them. What was needed, Chapple decided, was a factor that could be measured with the same accuracy as an engineer gauges the strength of steel or a chemist checks the amount of gas in a retort. And in human relationships the only measurable factor he could find was time.

To test his idea, he took a stop watch and some paper ruled off into seconds and traipsed around to factories, shipyards, and stores. He would observe two persons working together and note how often one spoke to the other, and how long, and how much time elapsed between chats or other contacts, like passing a pencil or a wrench. He



This interview will really give the low-down when the Interaction Chronograph has analyzed

it. Operator (foreground) sits unobtrusively by control box; machine itself is outside room.

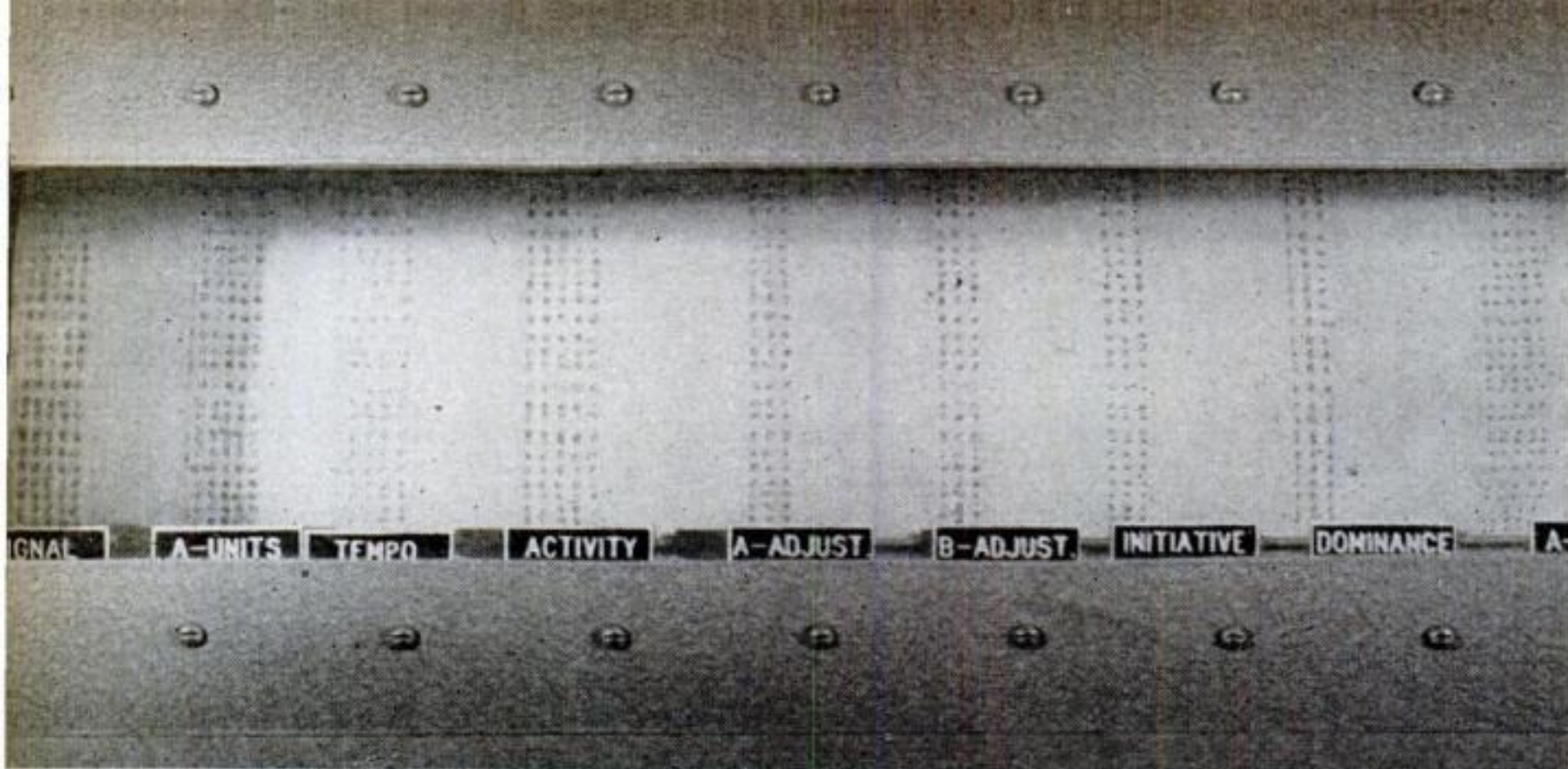
checked also on how quickly each responded to the other's remarks, and how fast a man would shut up or speed up when somebody tried to talk him down.

At first he was adventuring in the dark, but soon he noticed that individuals differed greatly in the frequency, length, and other time elements of their contacts with one another. Bill Jones, for instance, working at a lathe in the machine shop, often got in touch with the foreman but scarcely ever with Tom King, at the next machine; and Tom never spoke unless spoken to. Up in the accounting department it was Alice who usually answered the telephone although Mary sat right beside her. Out in the front office, Brown made many more contacts than White.

Now the problem was to learn whether or not these differences gave an accurate index of personality.



On control board, two upper left buttons start machine. *Signal* marks start of interview. Operator then holds down button A whenever subject talks or gestures; button B when interviewer is in action; both, when they talk at once.



Gray metal, waist-high cabinet at left holds the works of the Interaction Chronograph. Above at left is view, through the top window, of its columns of figures. In labels, *A* stands for subject; *B* for interviewer. *Signal* marks start of each

viduals in off-the-job interviews. The quiet machinist let the interviewer carry the ball. The phone-grabbing clerk was quick with her answers. Executive White took longer to restart a conversation than Executive Brown. In other words, the time elements recorded for an individual were much the same one time as another.

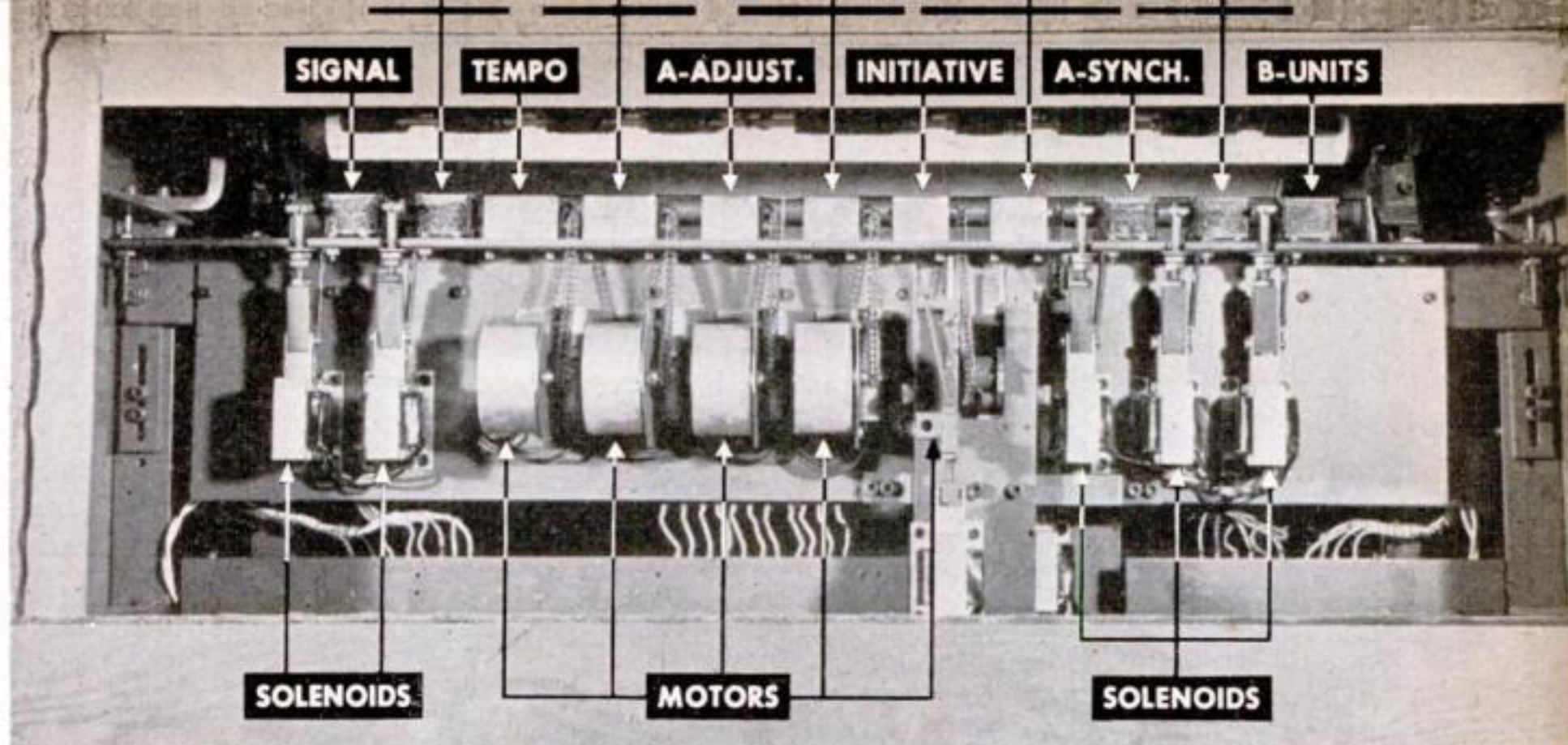
After checking hundreds of measurements against known facts about the subjects, Chapple and his associates were certain that time was an important measure of personality. They got other confirming evidence. Chapple's time lines for normal people differed markedly but showed that by and large one individual could adjust himself to another and manage a fairly even give-and-take. What about abnormal individuals? Chapple studied psychiatric patients at Massachusetts General Hospital and recorded wholly new patterns. These people were in the hospital because they could not adjust to other people. The fact that they could not adjust showed up clearly in the graphs calculated by his recorder. Furthermore, different disorders were characterized by different graphs.

Today's personality machine is just a development of the linked-together stop watches. The observer still has only two main buttons to control, but the device uses gears, electrical relays, and printing counters to write down the record not in lines but in figures—10 columns of them.

Here's an actual case of how it works. *A*

Chapple needed more data. To get it faster and more accurately, he replaced the stop watch with a simple recording machine, a continuously moving roll of paper on which lines were drawn when keys were pressed. When Mr. A spoke, his key was pushed down; when he stopped speaking, it was released. The same for Mr. B. When both spoke, both keys were pressed. In effect, Chapple had hooked up a stop watch for each subject and made them self-recording. The record told not only who talked and for how long but also who interrupted, who was responsible for silences, and who broke them.

With this device, Chapple discovered that recordings of individuals at work usually checked with recordings of these same indi-



division of interview. *Units* tell how many times each starts to talk—machine totals these at end. *Synch.* (synchronization) gives the total number of times person interrupts or fails to respond—this checks on adjustment. Other labels are

explained in text. Above at right is mechanism: the small metal rectangles at top are printing counters. They are activated by motors when duration of time is measured; by solenoids when frequency is measured.

big Boston department store wants a better line on its salespeople; first to be interviewed is a man from the furniture department. He sits down by the interviewer's desk in the personnel office. In a corner of the room is the observer, with his little black box. The Interaction Chronograph itself is at the end of a cable in another room, although tests have shown that it can be in the same room without disturbing the subject.

The I.C. in Action

We'll call the salesman Mr. A; the interviewer, Miss B. The session proceeds along lines standardized by Chapple. Miss B opens with a general question, "Well, how have things been going up in the furniture department?" She spends the next 8 or 10 minutes getting Mr. A to talk, limiting her questions to remarks like "Can you give me an example of that?" and "Isn't that interesting?" This is a free-and-easy period.

Then the interviewer slows down; she waits about 15 seconds before answering Mr. A and repeats the process 10 times. Next comes another period like the first, followed by another change of pace. This time Miss B interrupts, picks up what the salesman is saying, tries to talk him down.

Finally, there is another free-and-easy period, and the interview ends. It has lasted 25 minutes, and during the whole time the observer has been pressing buttons to record the interactions of Mr. A and Miss B—one button each time one of them spoke or ges-

tured. And in the next room the Interaction Chronograph has been busily computing the results for each period and the interview as a whole.

A skilled personnel worker might get something from a session like that, but with the I.C., the interviewer need not be skilled, need not ask searching questions, or even questions about the job. What Mr. A says is not important; only how, in terms of time, he says it. And no interviewer could get what the machine gives—a strictly scientific record that can be used to fit the subject to the job, or the job to the subject.

At the end, the observer lifts the hood of the machine, takes out the paper record of the interview, and finds that Mr. A started to talk 85 times, an average of once every 17½ seconds, and that his average talking period was 12 seconds longer than his average period of silence. These figures are basic: they measure what Chapple calls tempo and activity, which in Mr. A are relatively high.

While recording these facts, the machine has been comparing them with similar facts about the interviewer and totting up the results. For Mr. A, they show a good amount of *initiative* (during periods of silence it was often he who started the ball rolling again), and a fair degree of *dominance* (when Miss B tried to talk him down, he interrupted fairly frequently, neither relinquishing the conversational ball completely nor grabbing it all for himself).

Mr. A's *adjustment* was computed in several ways. One was the difference between the length of time he spent interrupting the interviewer and the length of time he failed to respond to her; for the interview as a whole there was very little difference. More important was his variability in activity and tempo—he speeded up or slowed down to meet changes in pace.

Now, what do all these measurements show about Mr. A's qualifications as a furniture salesman? To be able to answer that, Chapple had to set up standards by checking performance records against the I.C.'s findings. He also analyzed the job with a portable recorder and found that furniture selling is a relatively slow process. The average customer asks a great many questions and goes into long, often uninteresting, explanations about decorative schemes and her present furniture. The salesman must stick with her all the way, answering questions and giving her plenty of chance to think out loud, but cutting in if she hesitates too long or grows too long-winded. If she raises a quick series of objections to quality, style, price, he must be able to come back fast lest she walk out on the deal. In other words, his activity rating should be high, but his initiative and dominance only fairly so.

The Interaction Chronograph sized up Mr. A as the best man on the floor, and a study of sales records showed that, in fact, he was. His personality would have fitted him to do well in men's clothing, too, but at some hot-spot bargain counter, where a salesman has to handle two or three customers at once, he probably would have flopped.

Hose Outspeeds Hats

Store executives had wondered why their best millinery saleswoman, transferred to the hosiery department during a rush, had done a mediocre job. I.C. interviews with dozens of salespeople pointed to the answer: the best salesmen in quick-selling departments, like hosiery, showed a high activity rate in all five phases of the standard interview, while the best salesmen in slower-moving departments, where the customer had to be catered to, began the interview more slowly and were less dominant throughout. Other studies showed that a good department-store buyer has the drive and energy recorded by good salesmen, plus the initiative and dominance of good foremen.

The I.C. picked out similar significant differences among industrial executives. Chap-

ple began this study by interviewing 66 men, ranging from assistant foremen to production managers and supervisors. Then he compared the I.C.'s findings with those of the personnel office. The results surprise anyone who supposes that personality can be studied, sized up, and accounted for but not measured. They showed that *the machine would have selected in advance 92 percent of the men rated best by the company on the basis of long observation*. Time required by the personality tester: 25 minutes a man.

Executives Vs. Non-Executives

Next, Chapple compared his I.C. records for executives with those for 500 non-executives. As might have been expected, the bosses talked oftener and longer, were quicker on the uptake. Ninety-five percent of them ranked high in initiative and dominance, as against only 14 percent of the others. (Still, 14 percent of 500 is 70—70 potential executives hiding their light under the bushel of a workaday job.)

Finally, the I.C.'s inventor went looking for differences among the executives themselves—and found them. The best supervisors could speed up fastest after being interrupted, or when the interviewer failed to respond; their tempo fluctuated, showing that they could handle different kinds of people. The best production managers, on the other hand, tended to hesitate before answering questions. Foremen in the foundry, where work and personnel had changed little for years, had a stable rate of activity; foremen in the newer munitions division showed greater activity and aggressiveness. High-ranking personnel snapped back faster and took the initiative more often than executives under them. One foreman got a minus in aggressiveness, but all the men under him rated even lower—he had hired them himself.

Up to now, most of Chapple's work with the Interaction Chronograph has been exploratory, but it has solved a number of personnel problems. There was the ambitious young woman, for example, who was making life miserable for the few clerks under her, and for herself. Ranked high in dominance and energy by the I.C., she was given more supervisory work—enough to keep her busy instead of bossy. There was also the bright young production man who, boosted a couple of notches, made a mess of his new job by trying to do everything himself. The I.C. rated him high in activity but low in aggres-

siveness. Placed in a one-man department and given plenty of leeway, he was soon working out for his company valuable time-saving procedures.

These show how the I.C. can be used to tailor a job to fit the man and thus put unsuspected talents to work and prevent or cure personality troubles—which affect both the individual and his co-workers, and may eventually slow down a whole department. Of course, it can also be used to analyze a job—in terms of number, speed, and length of contacts required—and then to find the right man for it.

The I.C. is not the answer to every personnel question. It doesn't measure intelligence, but in most jobs, including executive ones, ability to get along with people is more important than sheer brainpower. It won't measure experience or training, but it will point to persons who, if inexperienced, are *worth* training. And it can tell whether or not a job applicant can meet the standards set by successful people in the same work.

So far, these standards cover a wide range of executive and sales work, and Chapple expects to catalogue others. He is now man-

ufacturing machines for lease, and his company has opened offices both in New York and Boston.

For some jobs it will be almost impossible to find standards. Chapple doubts that he could ever work out the personality traits that make a good baseball pitcher. But right now his machine could tell you in 25 minutes the best kind of manager for the Kentucky Kid.

Could it pick the best presidential candidate? The answer is no—but. It could not pick the man whose policies would be wisest. But it could point to the man with the drive and dominance to make his policies stick, and the flexibility and initiative to handle new associates and new situations.

And how about picking you a wife? Easy. It'll start with you first. Ah, a nice, calm, steady fellow. You don't interrupt; you listen more than you talk; you let a person cut you off. Why, you could marry almost anybody. . . . Wait a minute,—look here what it says about Mabel. Pretty active, Mabel; aggressive, but not too aggressive. . . . Go ahead—Mabel it is. With Mabel, son, you'll go places. END

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Miss Ruth Smith

N4 56
2/9/48

	N	Tempo	Activity	Adjustment A	Adjustment B	Init.	Dom	Synchron A	Synchron B	B-Tempo
Prelim.	15	41.26	22.66	.33	-2.80	-.20	.73	1.20	1.60	30.95
Stl.	10	44.10	5.80	-1.40	-1.21	.60	0	.90	1.00	49.00
Recov.	11	36.45	23.44	.90	-1.36	.18	.18	.64	1.09	40.10
Inter.	19	13.46	3.26	.40	.33	.07	.47	.80	1.00	11.88
Recov.	13	27.46	12.08	.53	-1.53	.23	.15	.69	.92	29.75
Total	64	31.56	13.47	-.50	-3.03	.14	.13	.87	1.14	29.70

Card summarizing I.C. tables (in background) reveals that subject is fairly adaptable (measurements for five periods vary) with fairly good initiative and relatively low dominance. She can listen well (difference between tempo and activity) and talks fairly well (activity). Her

tempo is decidedly slow. Chapple suggested she would make a good assistant to an aggressive executive (she isn't dominant enough to be a good executive herself), or a salesclerk in a leisurely field such as silverware (her tempo is too slow for average sales work).



Sound Without Fury

THE ridge-helmeted machine gunners at right, above, are "Aggressors." Their army, clad in forest green, is locked in battle with our own. It's all very real—except that they are firing blank ammunition. For these are friendly enemies, whose job is to make maneuvers as much as possible like real battle for the Army's raw recruits.

For their artillery barrage, in fact, this enemy doesn't even need guns. Realistic flashes and bangs come from the 105-mm. gun simulator shown at left, above. Of

British origin, it consists of a bank of metal tubes in which plastic shells containing cellulose nitrate are electrically detonated. An ounce of gasoline in the shell's nose explodes to make more flash. A switchboard controls the firing of the cartridges, either individually or in battery.

The firing of a 90-mm. gun is reproduced by a hopper filled with balls of nitrate. When a switch releases a ball, it rolls into a tube where it is electrically exploded. The advantage of both of these devices is that they can be handled by far fewer men than are required for actual artillery pieces.



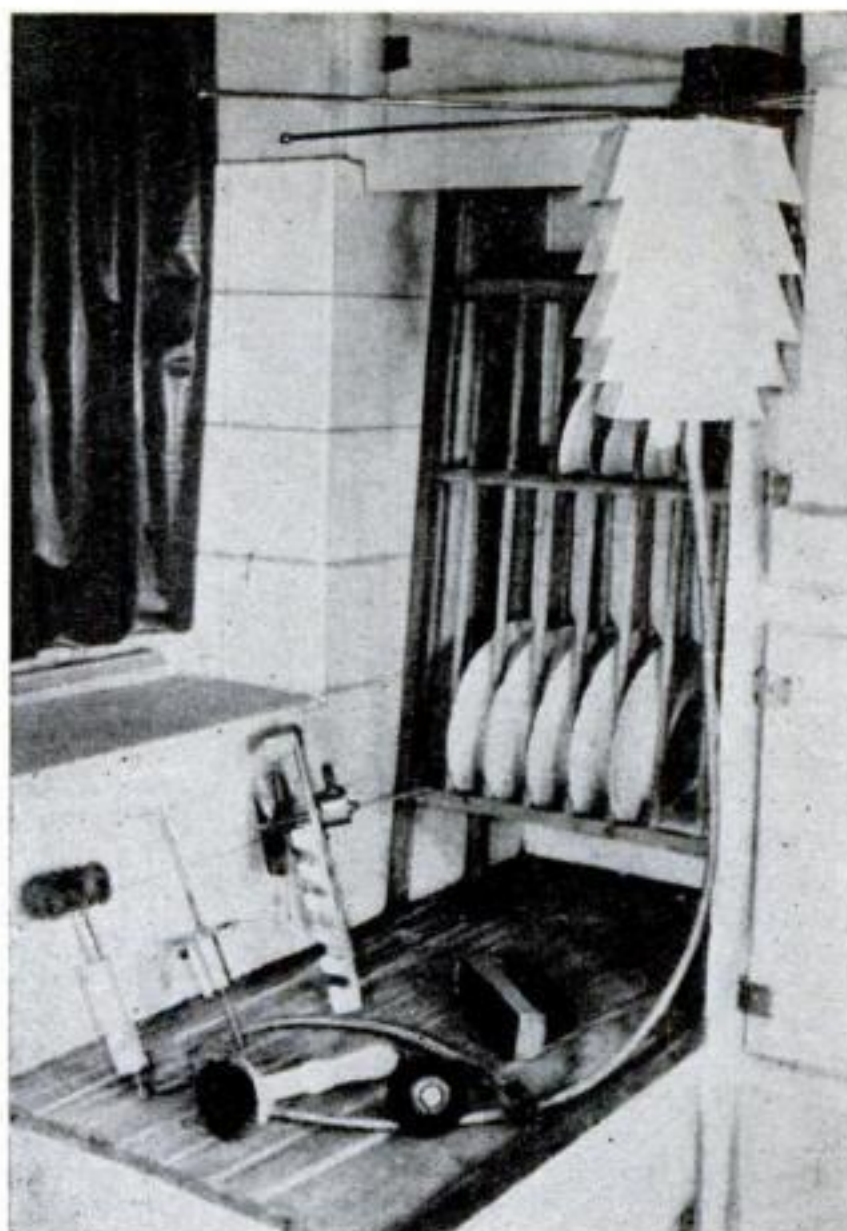
Soil Strength Measured

RESEMBLING a fancy walking stick, this penetrometer, stuck into sand or clay, tells how heavy a load the soil will bear without bogging down a vehicle. A small metal cone on the tip of the stick is pushed into the earth until its top is level with the ground. As the operator presses the cone farther into the ground, the steel spring just under the handle is depressed. The amount the spring is depressed can then be read on the dial, giving an accurate measurement of how much of a load the soil can take.

Designed during the war to determine what equipment could be moved by the Army along beachheads, the penetrometer has been further developed by the U. S. Waterways Experiment Station, Vicksburg, Miss. Tanks, trucks, tractors, and amphibious vehicles are used in the tests.

K. P. Chores Made Easy

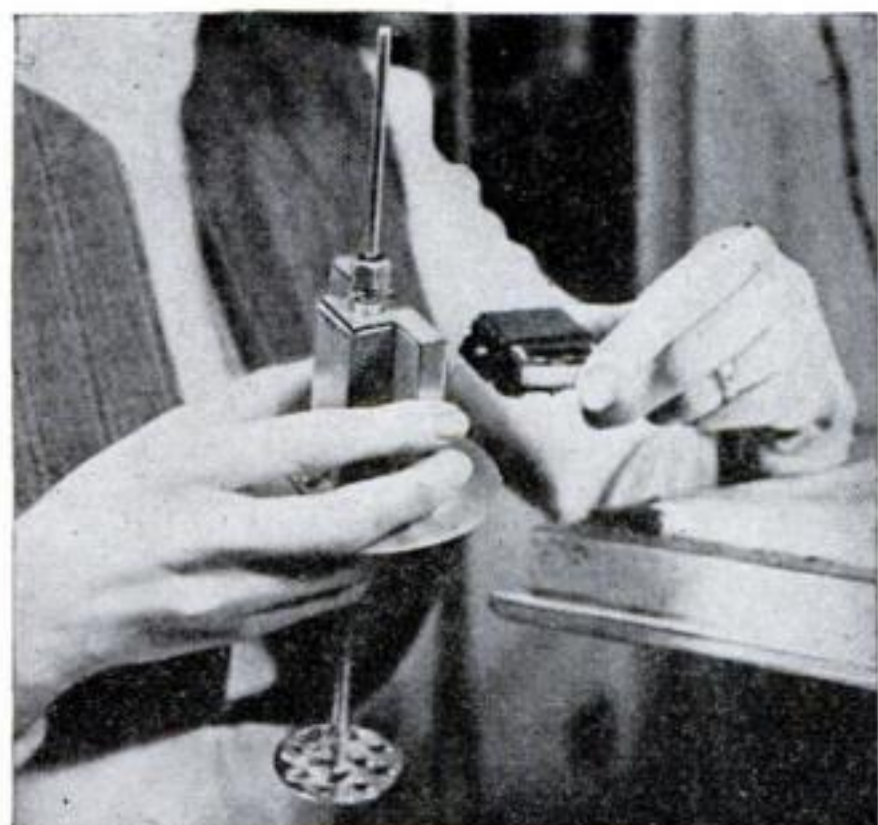
YOU may have only two hands, but with this new British device in your kitchen you will feel like triplets. Called the Electro-hand, it scours, polishes, mixes, whips, and even dries your towels. The driving unit, an electric motor, is seen at top of the picture at right. A heater is built-in for drying dish cloths on rods above, warm air being blown down from under the top. The flexible drive cable seen hanging down is fitted with a universal adapter that plugs into the various attachments on drainboard.



Resembling an inverted nest of flower pots, the driving unit, shown at top, right, is fixed to the wall with a two-screw bracket. A pilot light fitted under the unit illuminates drainboard working space. The lamp and motor consume 60 watts, the heater, 250 watts.



Silver polishing, as at left, is a pleasure with this high-speed, rotating brush that even reaches the hard-to-get-at crevices. Buffer on the table does a high-polish finishing job.



The universal adapter, about to be plugged into the egg-beater and cream-whipper attachment. The plunger, with a perforated plate at one end, adapts itself to a container of any depth.



A polishing pad is used to give shoes that lustrous shine. It is interchangeable with a brush that does the preliminary dirty work, and is ideal for cleaning large surfaces.

Rockets Lay Phone Lines

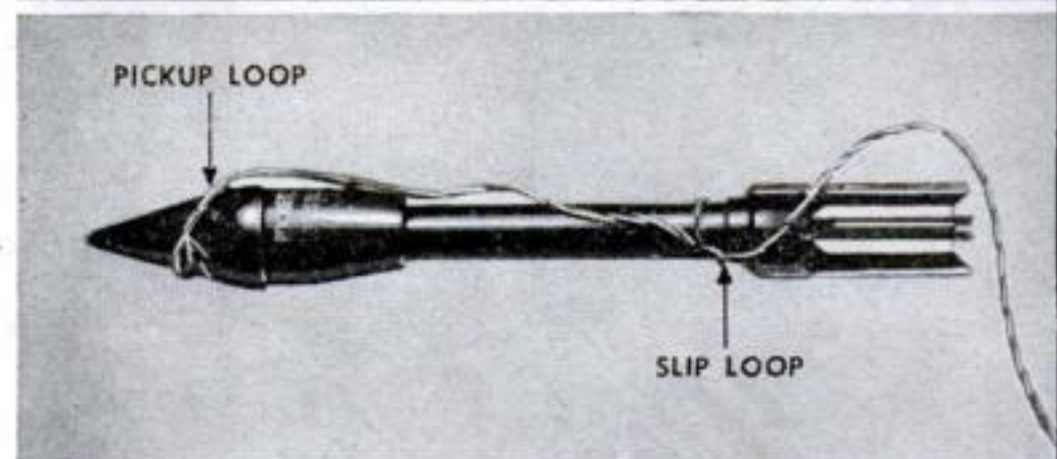
SIGNAL Corps linemen are adding rockets to their tool kits. The fiery missiles pull telephone wire from a new type of dispenser across streams, ravines, and other obstacles. One man, equipped with the dispenser, a few rockets, and a field telephone, can now set up communications in rough terrain faster than a large crew using conventional methods.

The new wire dispenser was developed from a model used during the war. With it, the wire-laying rocket may be fired without a launcher. The rocket is set off in the original cardboard packing case, which is placed in a wedge-shaped hole dug in the ground. Even when fired in this manner, the rocket will carry wire as much as 150 yards.

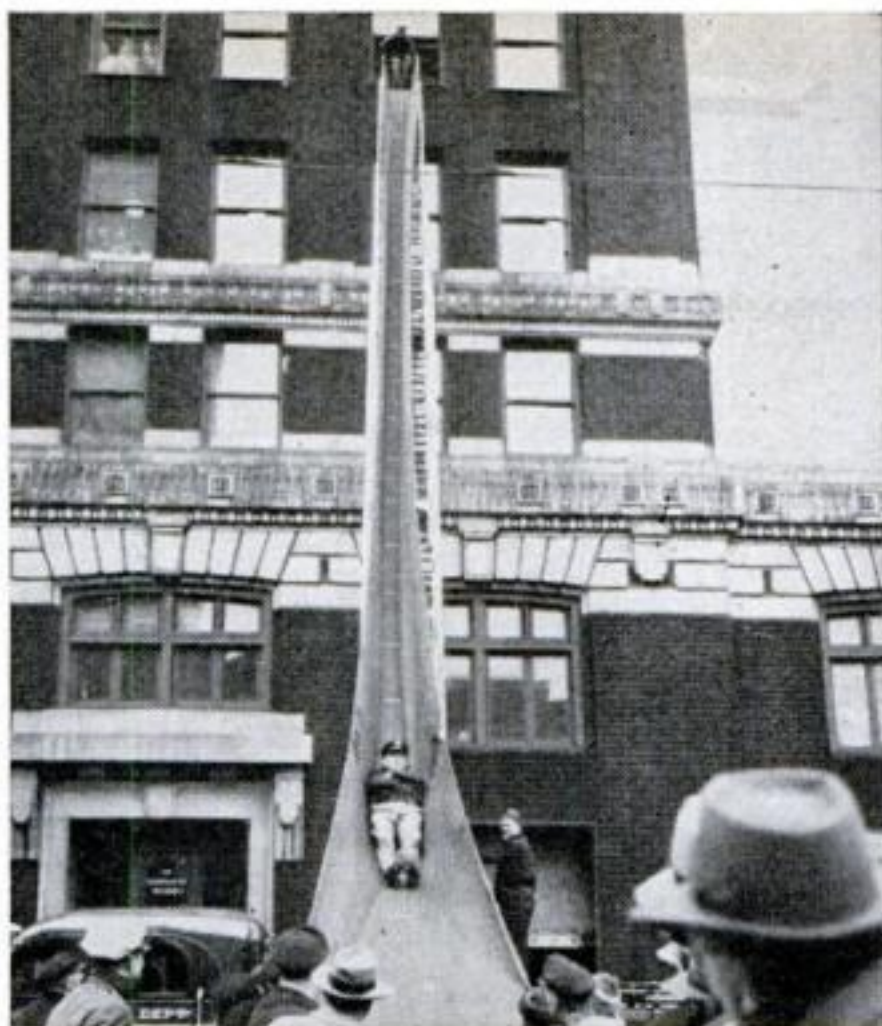
The dispenser itself is intended to aid all kinds of high-speed wire laying. It pays out wire from moving airplanes and trucks, or from a bazooka. Or it can be carried on a soldier's back, laying wire as he walks. Made entirely of noncritical materials, the new dispenser weighs about 28 pounds when full. It holds a half mile of "infantry wire," another recent Signal Corps development that gives a telephone talking range equal to the widely used field-type wire, but weighs only a third as much.



Signal Corps' new wire dispenser lays telephone lines from speeding airplanes, trucks, and even rockets. It is shown above mounted under the wing of an L-5 liaison plane.

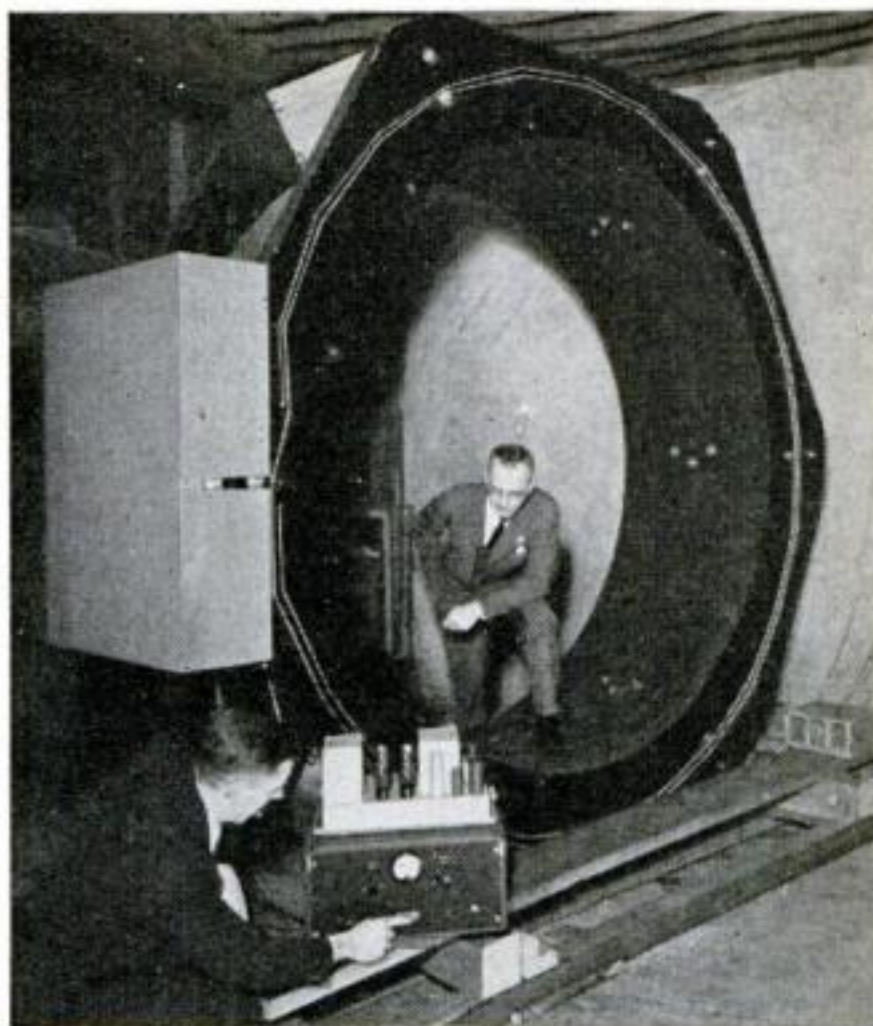


This is the easy way to lay phone wire across a stream—shoot it over with a bazooka (top). Photo below shows how wire is fastened to rocket, which pulls it from reel on ground.



Slide to Safety

A NEW escape for people trapped in a burning building, the fire chute shown here is made to reach as high as the average tenth floor. Up to the fourth floor, the top end hooks onto the window sill or some object such as a radiator inside the room. For reaching higher floors, it is attached to the end of an aerial ladder and held against the window. The chute is six feet wide, and made of water-repellent, fireproof canvas. The manufacturer, Eastman Evacuator Co., of Detroit, claims the device can evacuate people at the rate of one a second.



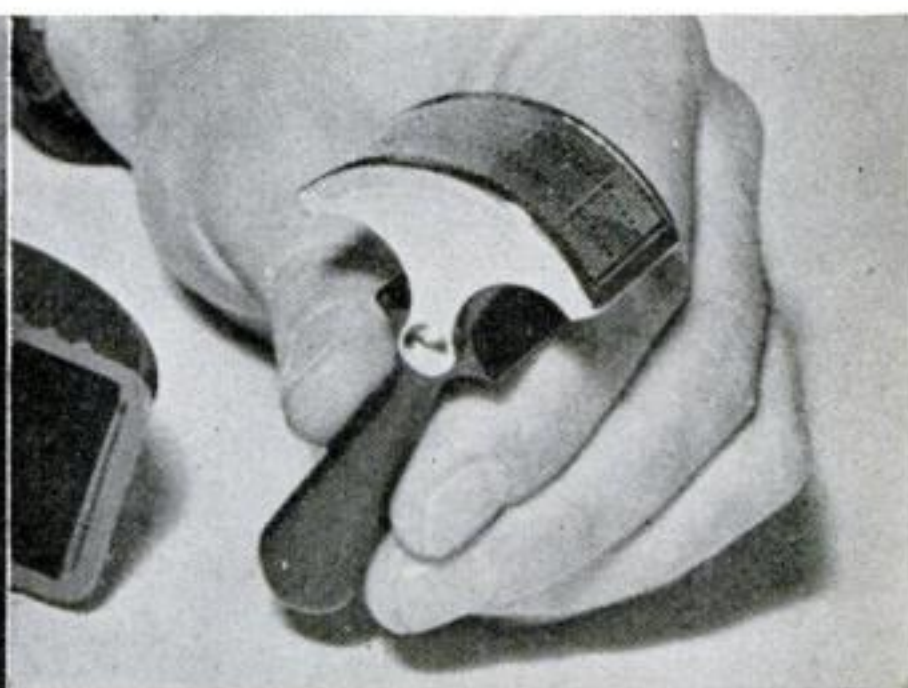
Lumber Is "Loaded"

HARVESTING of more than 3,700 acres of timber on the Ft. Lewis Military Reservation, Washington, came to a standstill when it was discovered that the trees were not only liberally sprinkled with metal fragments, but that some even contained unexploded shells. When ordinary detectors proved useless in spotting the embedded metal, General Electric came up with the electronic detector shown above. The device is placed in the water; when logs are floated through its magnetic field, the presence of metal is announced by visual and audible alarms.

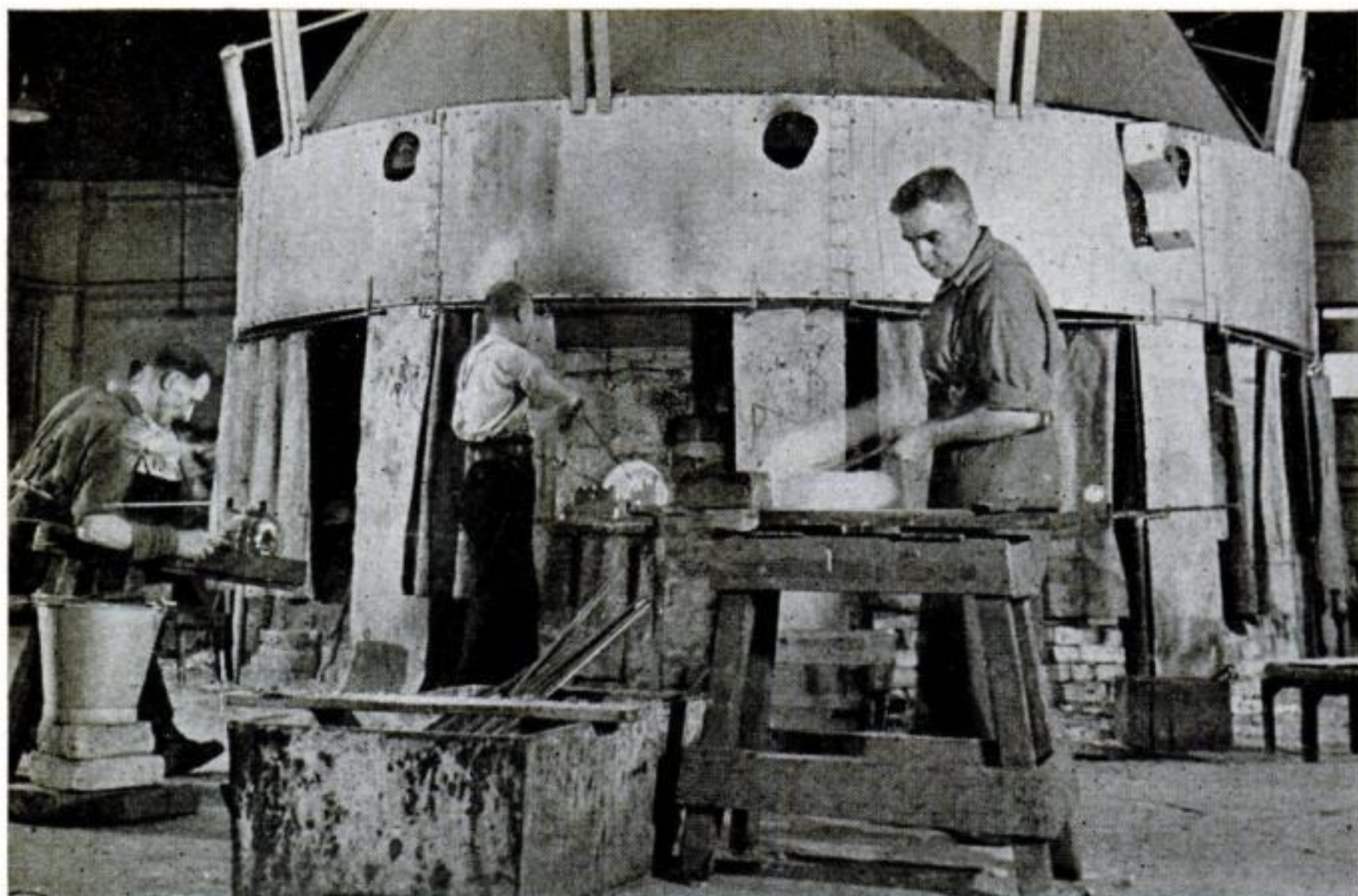


Rock-A-By Razor

THIS nonelectric razor gives you a dry shave when you hold it against the skin and rock it gently back and forth. Its two blades, explains the British manufacturer, cut



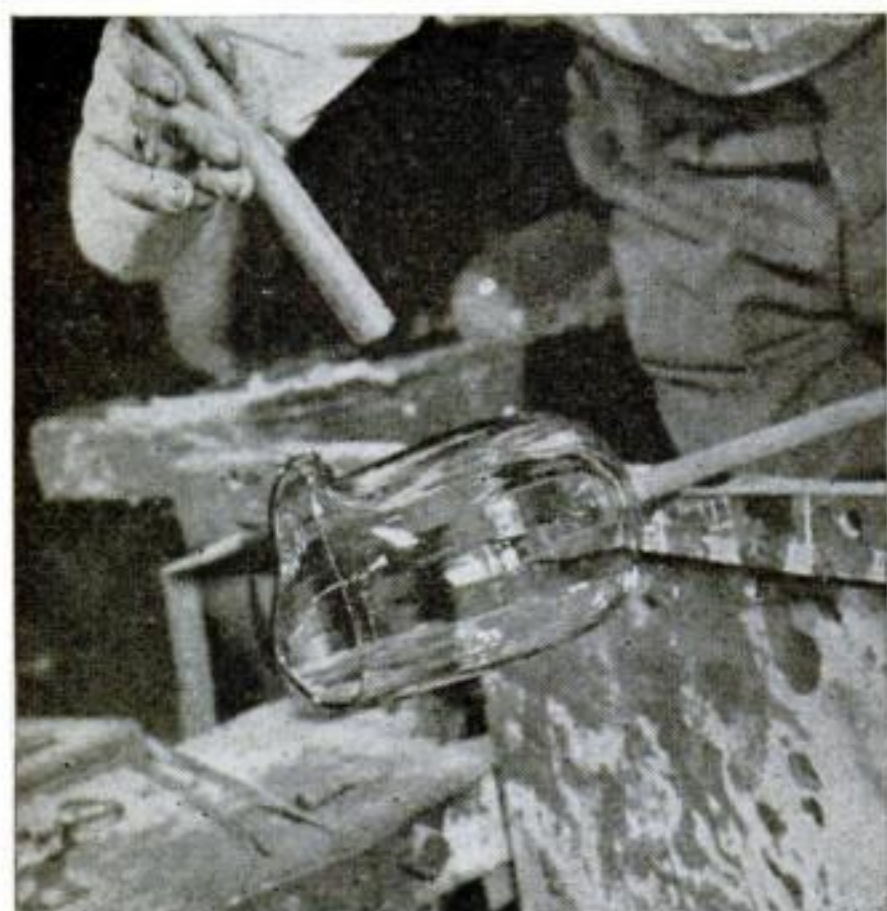
the whiskers by a scissors movement. At the same time the guard sharpens the blades, and is said to give them a life of several years. The blades, moving in a half circle, crop the beard bristles that project through the perforated guard shown above.



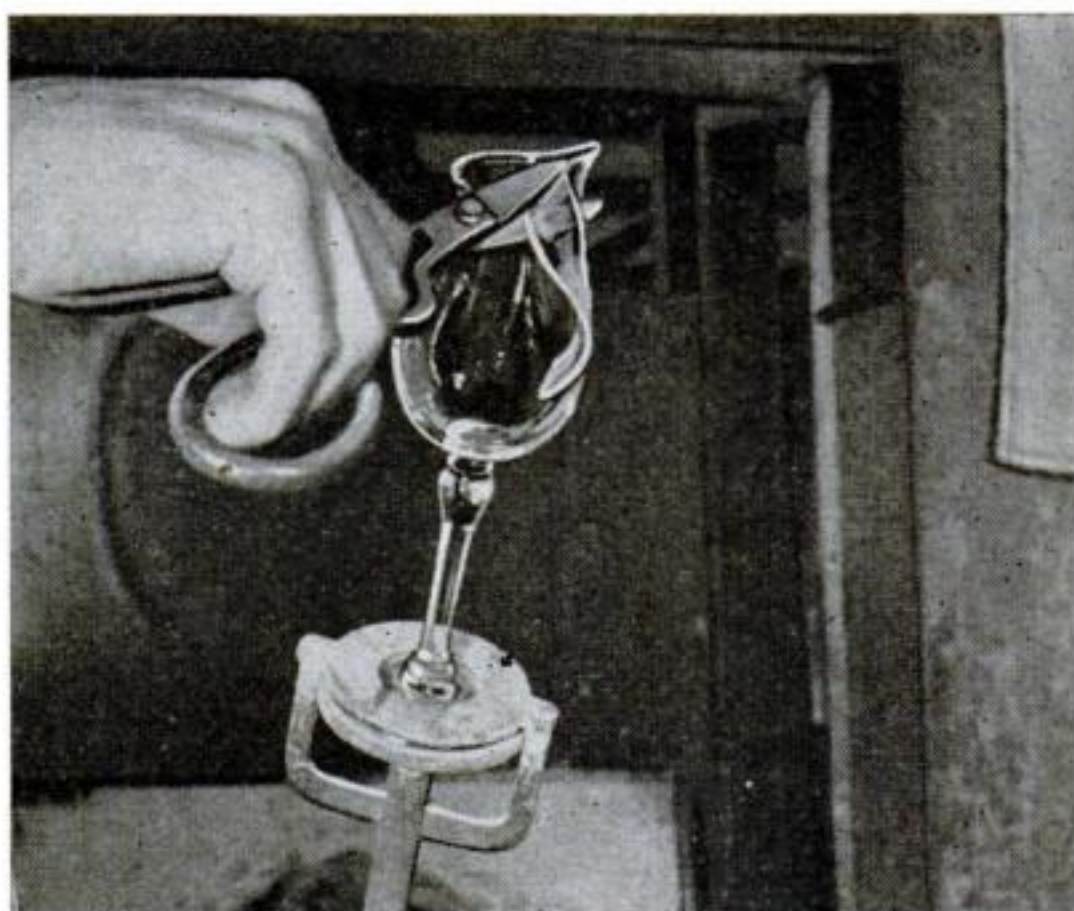
This modern glasshouse is scientifically lighted and is cooled by electric fans. Furnaces can be fired with either oil or gas; pot openings are covered with asbestos curtains to keep the heat

in. The workman in center background is "gathering" molten glass from the furnace, while the craftsman at the right is "marvering," or rolling the hot glass to give it shape.

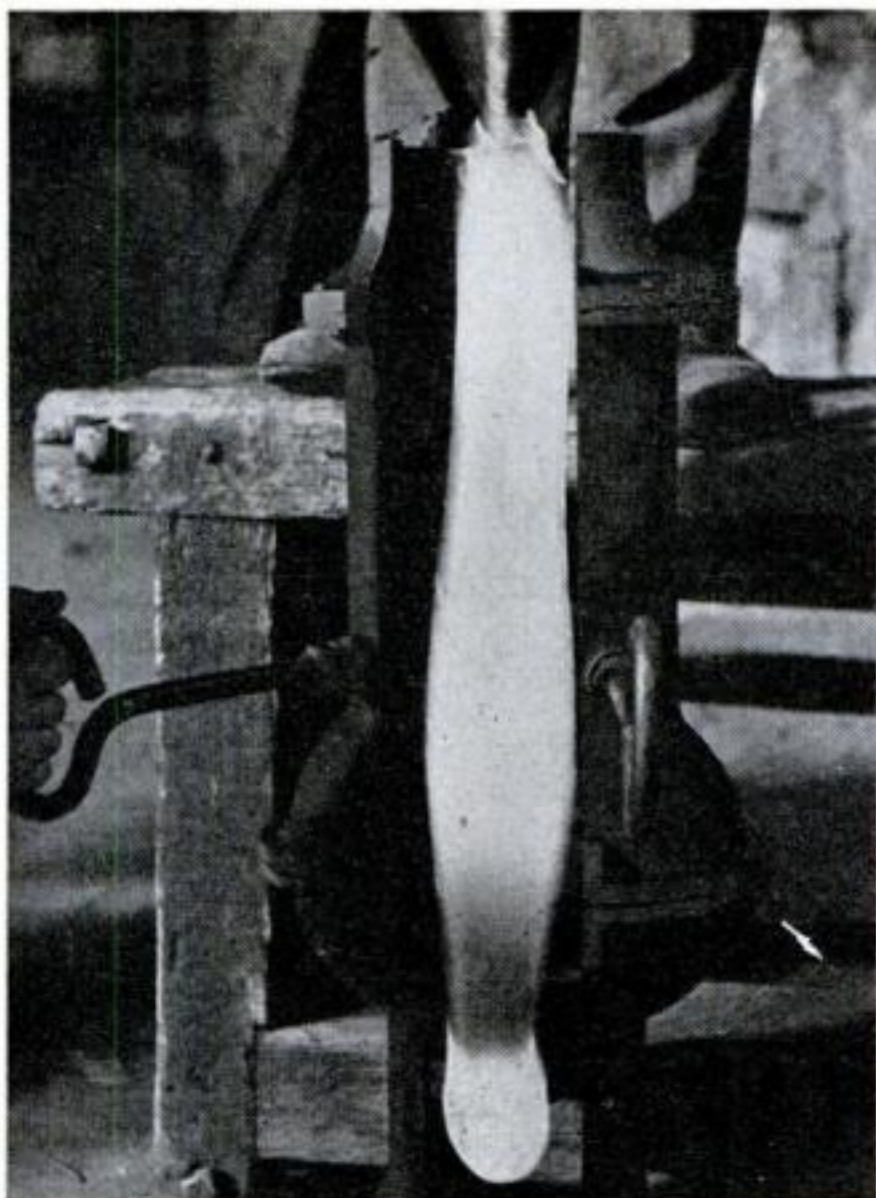
How English Experts Handle Glass



A lip is being formed on a jug by a skilled workman called a "gaffer." Taking over after a "servitor" has shaped the glass, he does such jobs as fitting handles and cutting off waste.



Here waste glass is being sheared off the top of a wineglass. Before this step, the open end of the glass has been reheated in a small subsidiary furnace, called the "glory hole."



Glass on a blowing iron is inserted into a mold coated with a carbon deposit that acts as a lubricant. As the blow pipe is rotated, the article is blown up until it is shaped and set.

A THREE-FOLD expansion is planned for Britain's hand-blown glass industry, which has had its center in Stourbridge for almost 400 years. Despite improvements in furnaces and working conditions, as these



A beautiful example of the hand-blown glass-maker's art against a background of the tools required to produce it. Cutters range in size from a pinhead to eight inches in diameter.

photographs reveal, the craftsmen of today still turn out their exquisite lead crystal glassware much the same way their ancestors did. It is an hereditary trade, and a team of glassmakers is still called a "chair."



A battery of flame guns, left background, glaze the ground tops of tumblers. While faster than the "off-hand" or handmade method, this newer process produces a less perfect finish.



A glass cutter working at his wheel. The design to be cut is marked in roughly as a guide, but the highly skilled craftsmen work free hand, and they create many of their own designs.

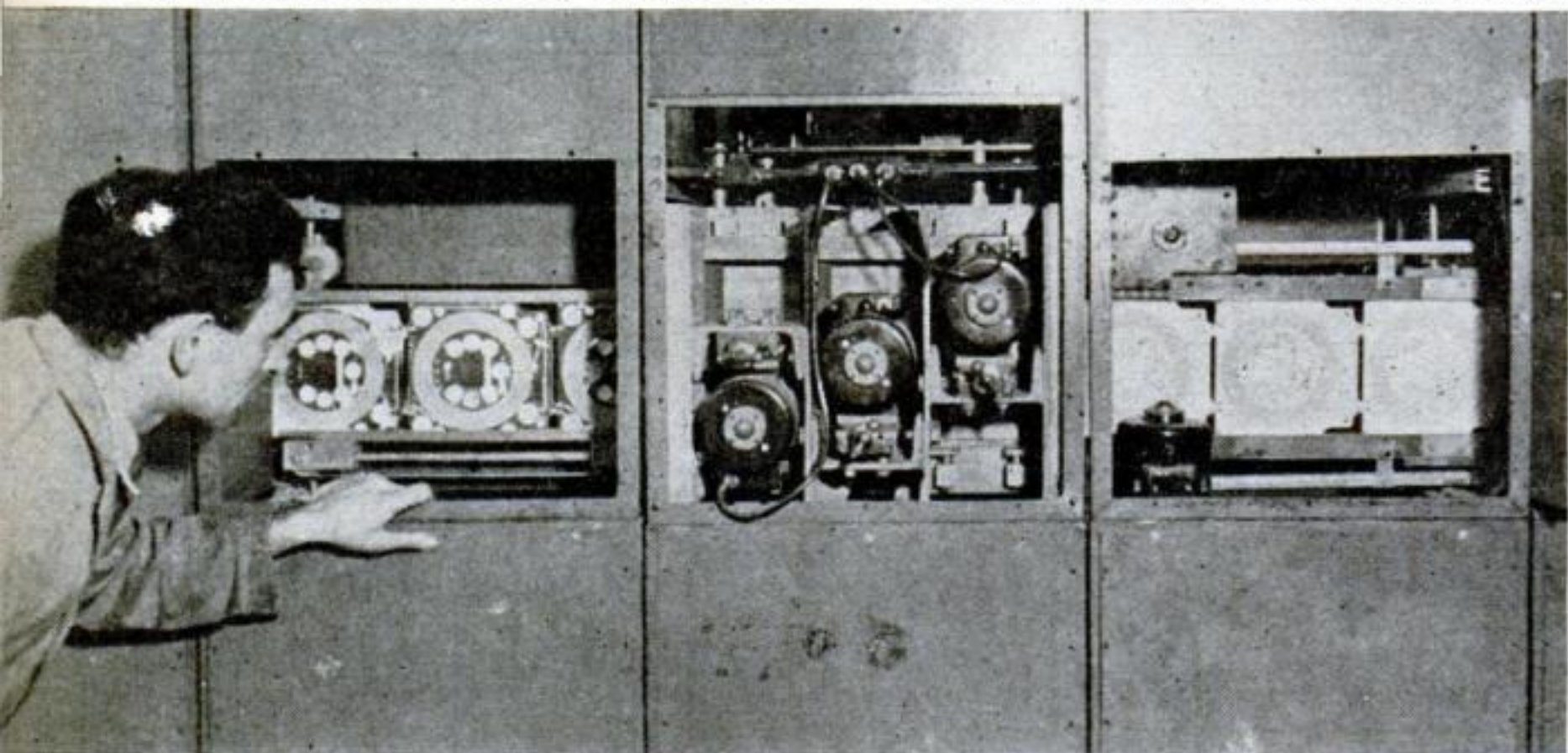


1. The two rows of robot radio-set makers above form a corridor 70 feet long. Girls seated in the foreground are feeding plastic plates into the device. As these move down the line, a

series of automatic machines, governed by 20 electronic "brains" and "memory units," build up all the necessary circuits in the plates' pre-formed grooves and depressions.

2. After going through a sand-blasting unit, the plastic plates are sprayed all over with metal, filling in the grooves of the circuit pattern. At right, below, the fully metaled plates

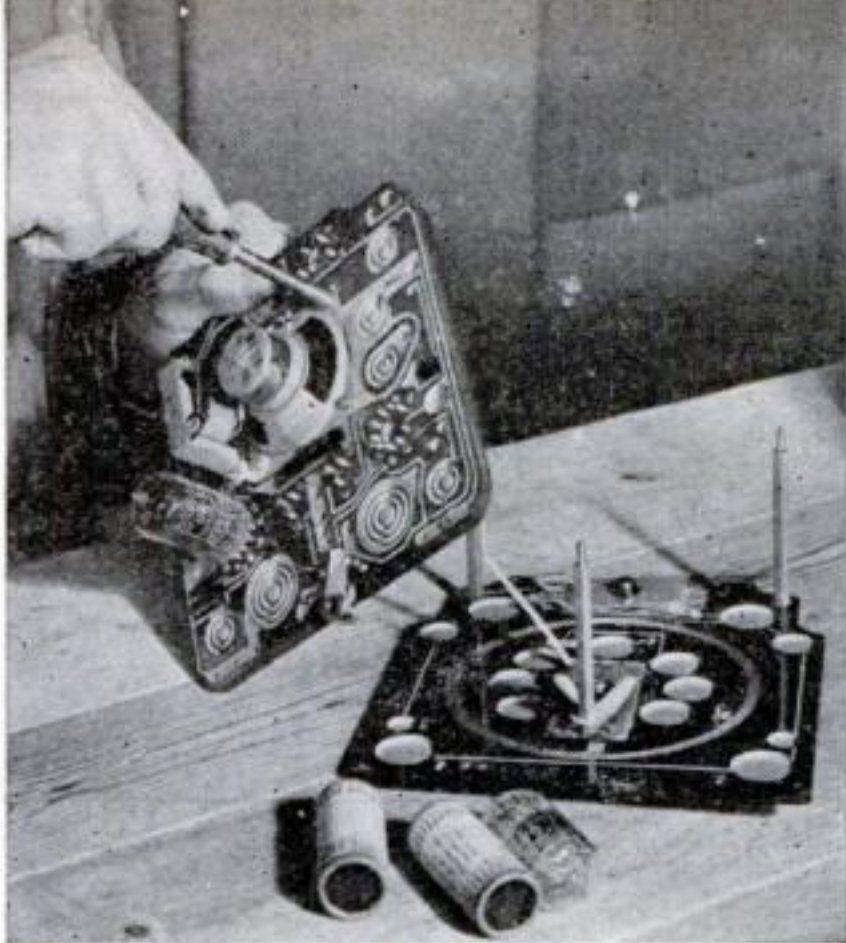
are passing from the spraying unit into the face-milling unit, where surface metal is removed by high-speed diamond tools. At left, an inspector watches the freshly milled plates emerge.



Radio Robot Squirts Out 3 a Minute

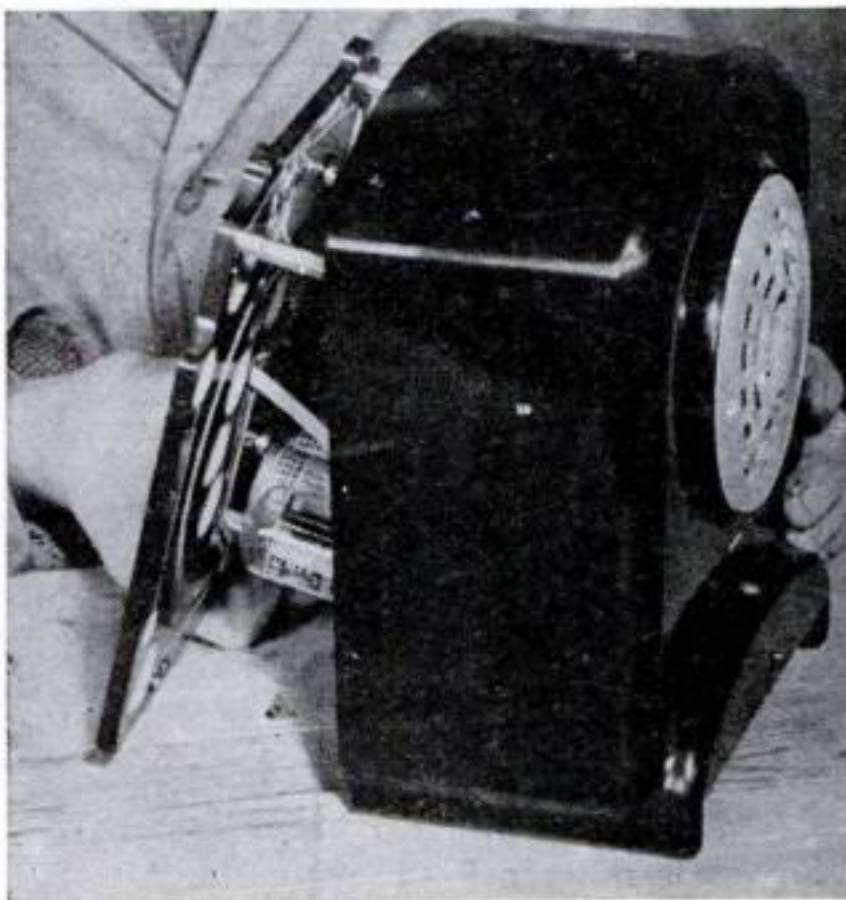
A COMPLETE radio set every 20 seconds is the production goal of this new British automatic machine known as ECME (Electronic Circuit Making Equipment). Nearing completion at the research laboratories of Sargrove Electronics, Ltd., this automaton uses the sprayed-circuit technique to do the jobs of a double line of skilled workers. Wiring mistakes are eliminated, and the machine even makes its own tests, signaling the location of any defects in the circuit.

Plastic plates are fed into each end of the two parallel rows of electronic units shown

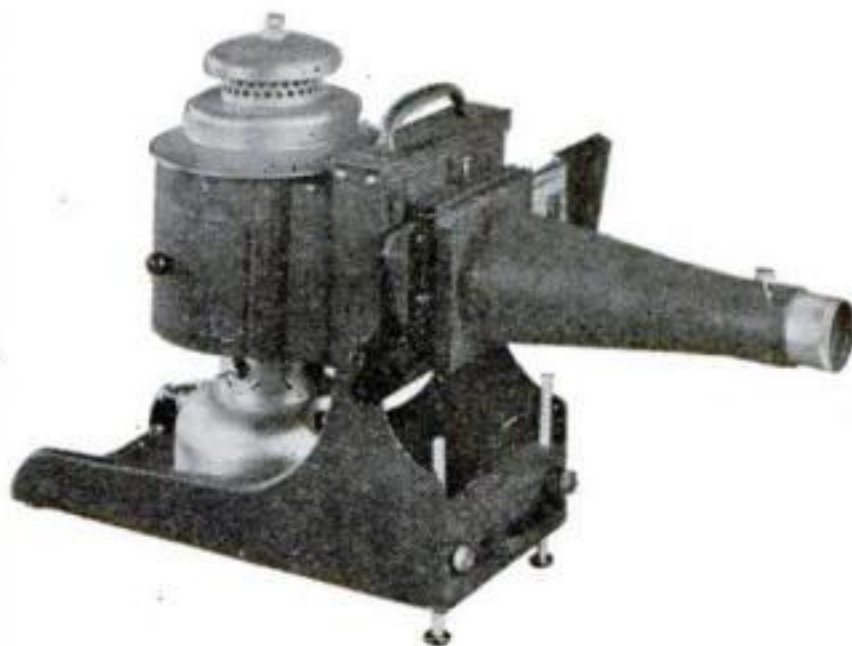


3. The complete "metal-grown" circuits can be seen above as a handworker takes over, adding a few finishing touches. At this stage vacuum tubes are fitted and the loudspeaker attached.

4. The whole assembly, fitted together, is then slid into a molded cabinet (below). During the 20 seconds it takes to turn out a unit, only three pairs of hands have touched it.

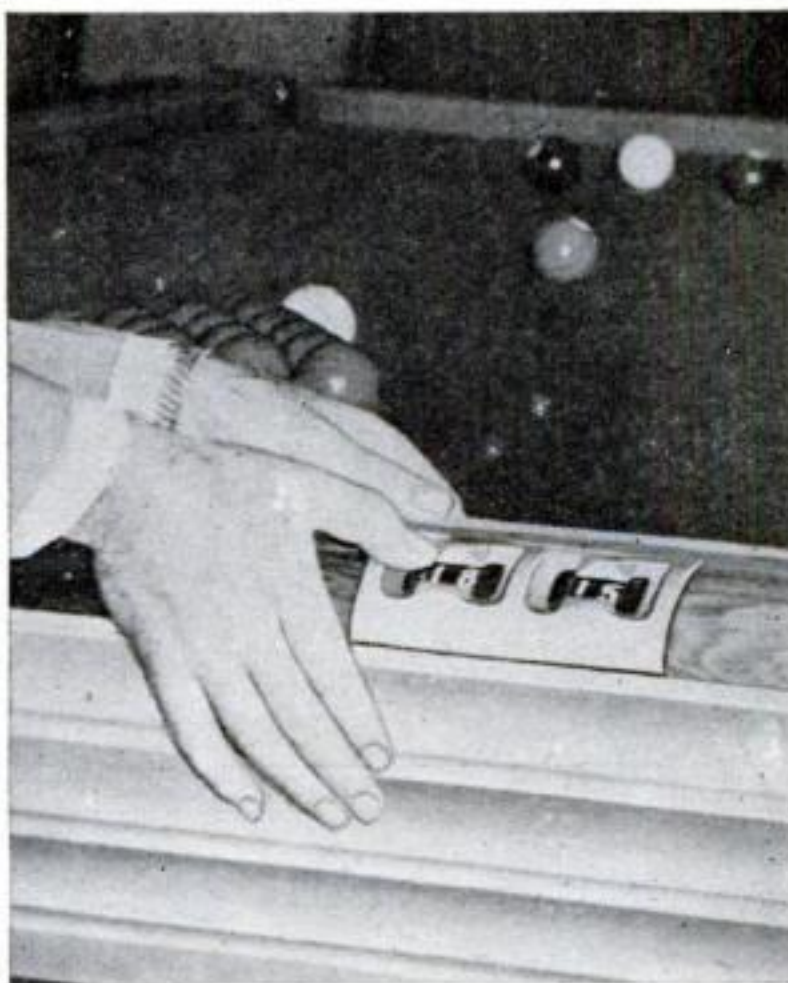


in the photograph at the top of p. 160. As the plates move down the line, all the necessary inductances, capacitors, resistors, and potentiometer tracks are "built up." After lacquering, other units automatically insert rivets, eyelets, and studs. When two plates are joined together at the end of the line, they form a complete radio receiver except for a few parts such as electrolytic condensers, tubes, and loudspeaker, which are added by hand. It is claimed that the sets will be both lighter and sturdier than those made with wired circuits.



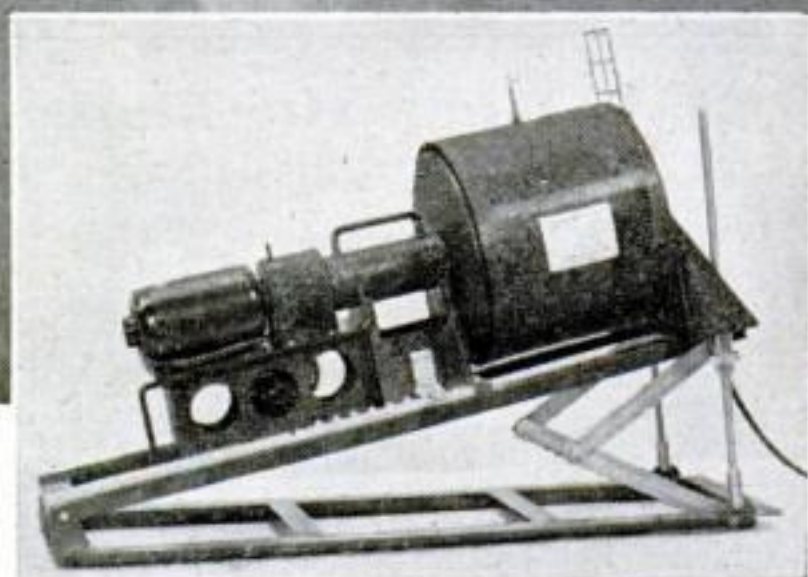
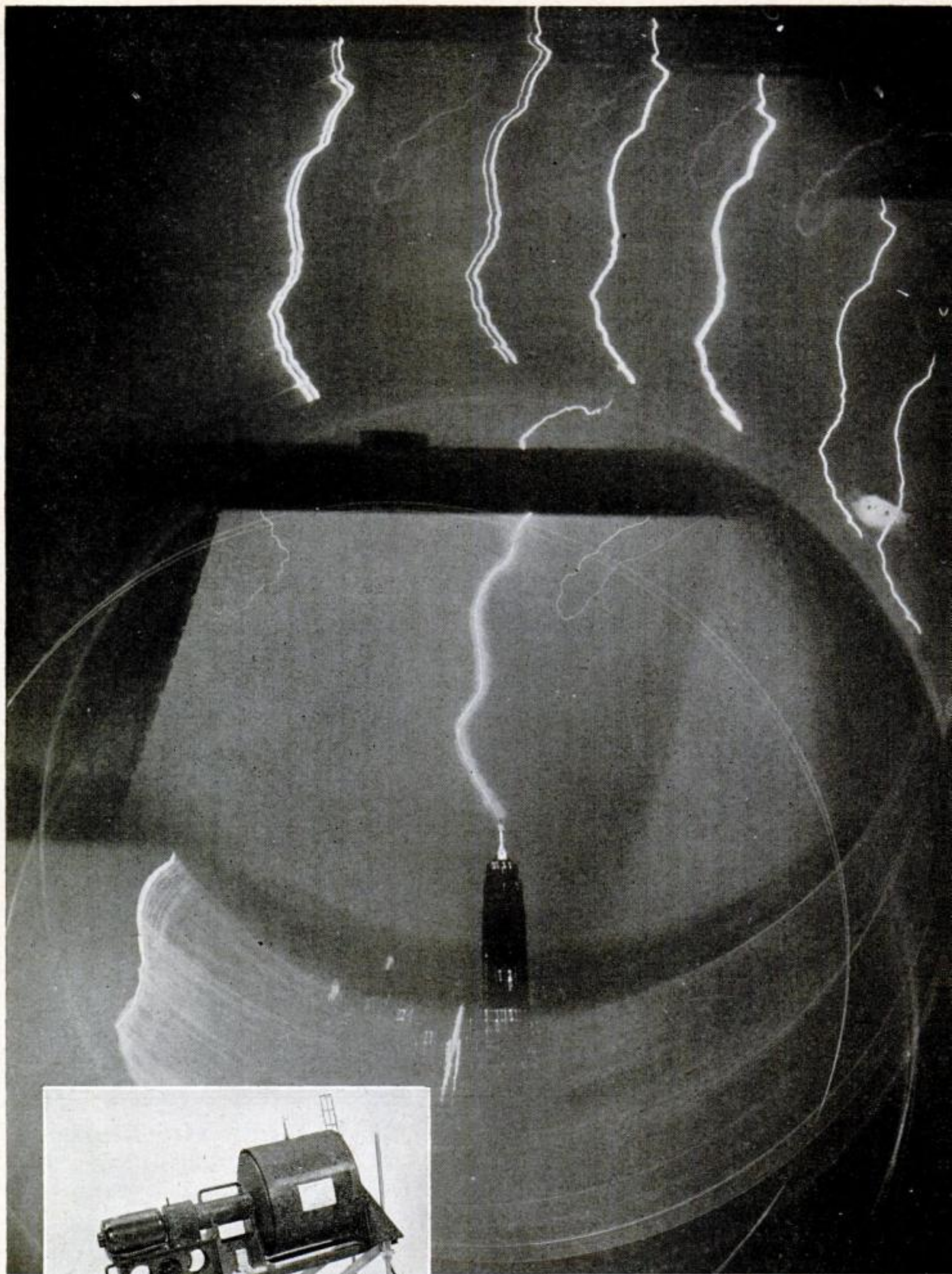
Projector Uses Gas

THIS slide projector, operating on gasoline or kerosene, will bring visual education to communities in the United States and foreign countries where electricity is not yet available. Developed by the Charles Beseler Co. at the request of the U. S. Office of Education, it uses a standard Coleman mantle lamp. The projector takes slides and 35-mm. strip film.



Dials Keep the Score

BILLIARD rooms need no longer have unsightly string counters hanging overhead. The point-counter dials shown above, a product of the Brunswick-Balke-Collender Co., are built into the billiard table's rail. The device consists simply of numbered dials turned by thumb wheels. There are two dials for each player's score, so he can keep count up to 99.



Microsecond technique splits a lightning flash. GE's special camera (inset) shows that bolt striking Empire State Building (center of photo) is one slow discharge and six fast ones.

Seconds Split a Million Ways

Measuring the split flashes of time that are microseconds makes possible many modern miracles of science.

By Carl Dreher

IT TOOK you about one second, or 1,000,000 microseconds, to read the title of this article. On that basis one microsecond may seem short enough to satisfy everyone, but to the modern electronics engineer it is a fairly long time. Describing a new electronic gadget, its inventor informs us that each dial division corresponds to 0.0132 microseconds; in other words, he is measuring down to a *ten-thousandth* of a *millionth* of a second.

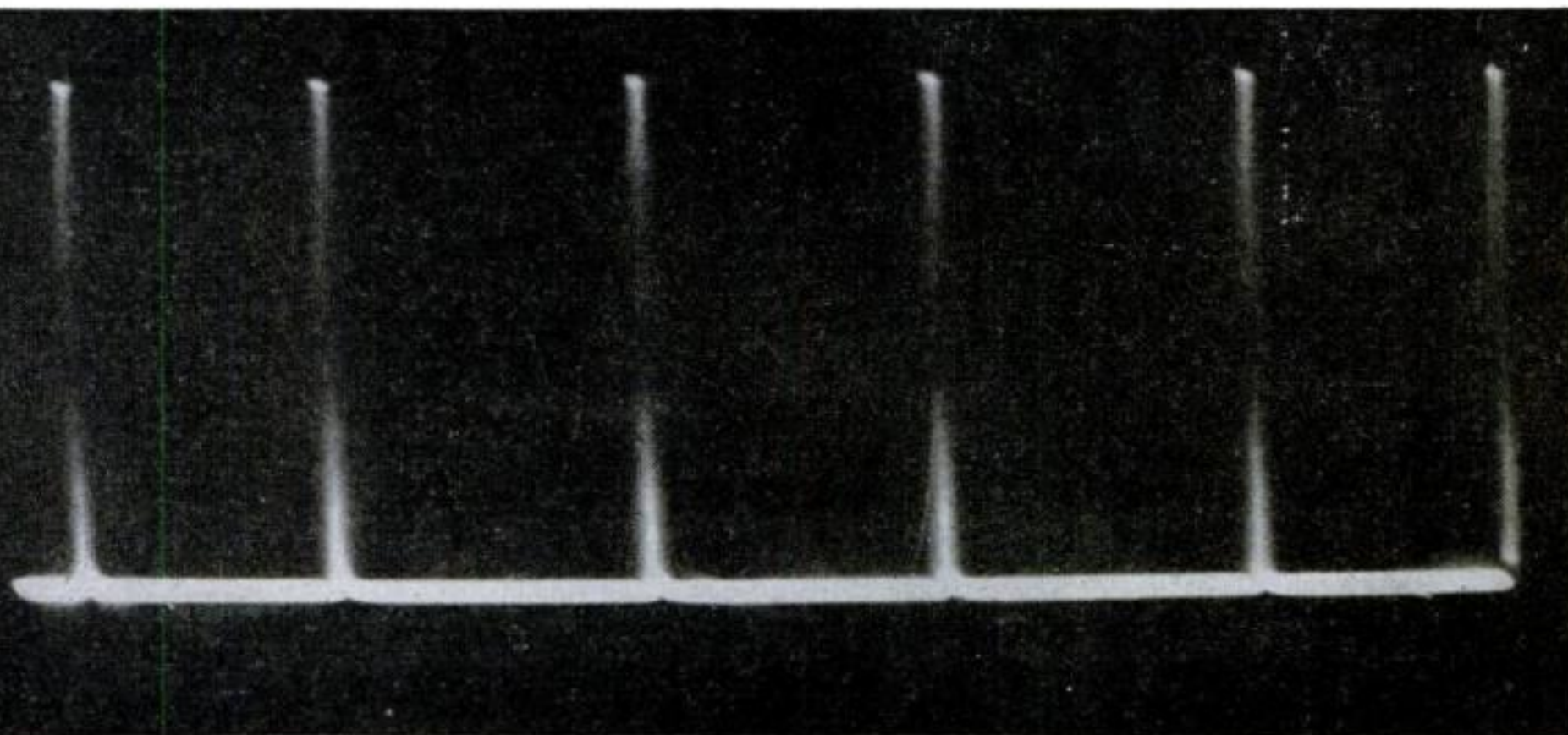
That's slicing it rather fine, but if it is worth a few dollars to you, you can buy a pulse generator that will deliver bursts of power adjustable down to 0.1 microsecond. You can order it from an advertisement—nothing special about it—plug it into a wall socket like an electric iron, and you're a member of the microsecond-splitting fraternity yourself. It's economical to operate, too—consumes only 40 watts.

Is all this just a scientific stunt? Hardly, unless the major part of radio and electronic

development during the last war and between the two wars is to be so regarded. Actually it represents a major technological revolution. If some Rip Van Winkle radio engineer awoke today he would hardly recognize the science he pioneered. Where he figured mainly in kilocycles, he would hear his younger colleagues talking megacycles and thousands of megacycles. Where he was concerned with the production of continuous waves, he would find bursts or pulses of energy playing as important a role.

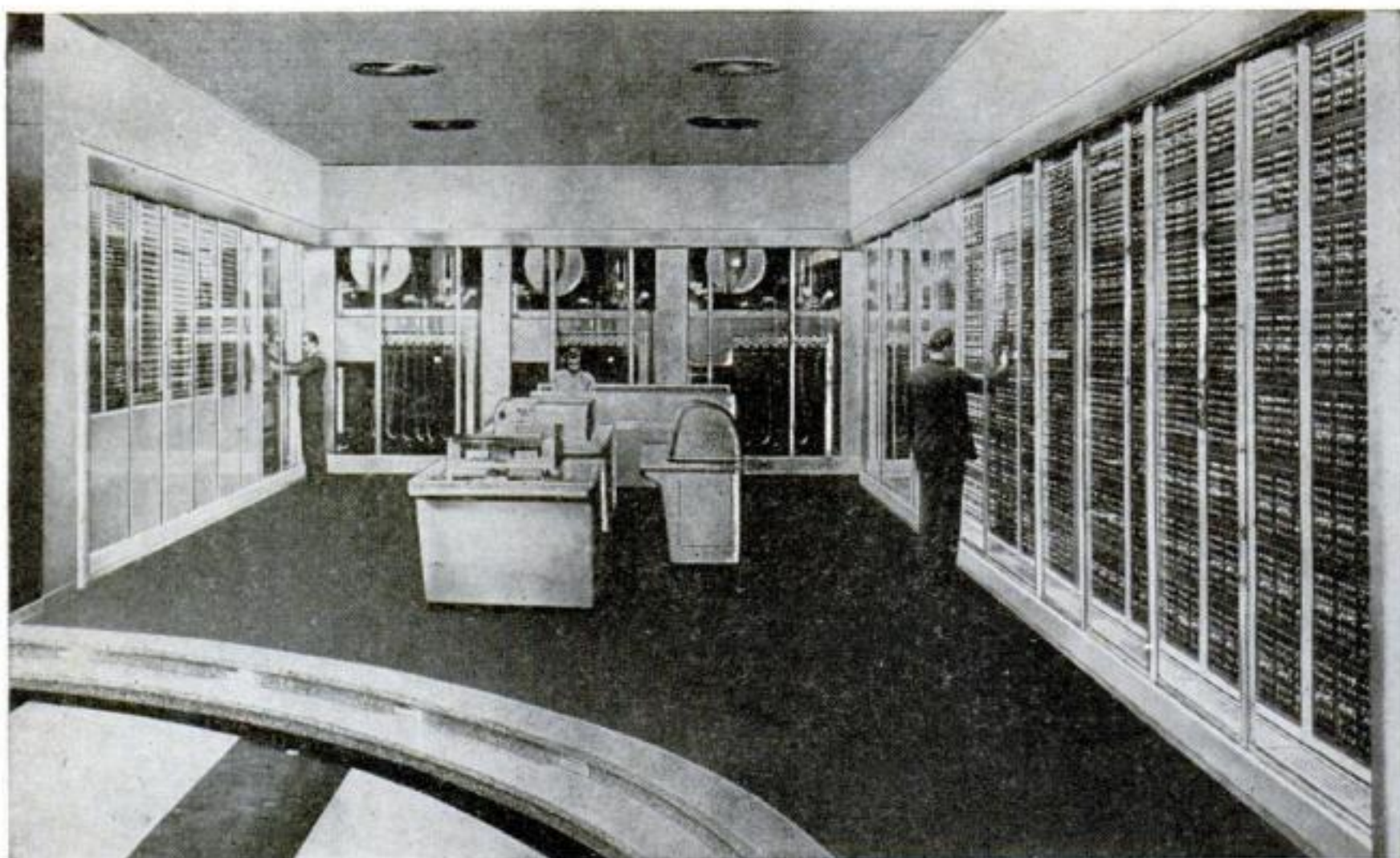
The technique of producing these pulses would seem especially odd to him, for if he worked with vacuum tubes before his long sleep he would remember that the first rule was to avoid overloading and consequent distortion. Many circuits in use today by their very names—clipping, blocking, slicing, limiting, leveling, square-wave, etc.—show that they are designed to distort wave shapes rather than to preserve them. Finally, he would discover these strange contours manipulated with a split-microsecond accuracy unknown in his time.

The most important practical development of these techniques is radar. We usually think of radar as a system of blind bombing or obstacle detection. Basically radar is



Microsecond pulses look like this when viewed on an oscilloscope. Photo above shows six of the ten pulses transmitted in Pulse Time Multiplex radio system developed by Federal Telecom-

munications Laboratories. Each of eight pulses carries different program; others are markers. PTM receiver unscrambles the pulses so that you hear only the program you choose.



High-speed computers, such as the giant just placed in operation by International Business Machines Corp. (above), use electronic pulses

to solve the most difficult mathematical problems. IBM's monster computes the position of the moon—186,260 operations—in seven minutes.

a system of time measurement of exquisite precision, and what we see on the scope is only a derivative of what we measured in microseconds. We send out square-shaped pulses, usually of one microsecond duration, pick up the reflection from a target, measure the elapsed time electronically and automatically, convert it into distance, display the result on a tube, and that's radar.

Used in Navigation Aids

Another application of microsecond technique is the Loran navigation system (PS, Feb. '46, p. 78). Like radar, it uses rectangular pulses, but they are transmitted on a comparatively long wave length from a number of widely separated locations. Thus they cover a much greater range than radar, which, like television, is limited to the optical horizon. The method is to measure the time of transmission from each transmitter and thus to obtain a fix by triangulation. The individual pulses are relatively long—about 40 microseconds—but it is a split-microsecond technique, for the transmitters are synchronized to within 0.5 microsecond.

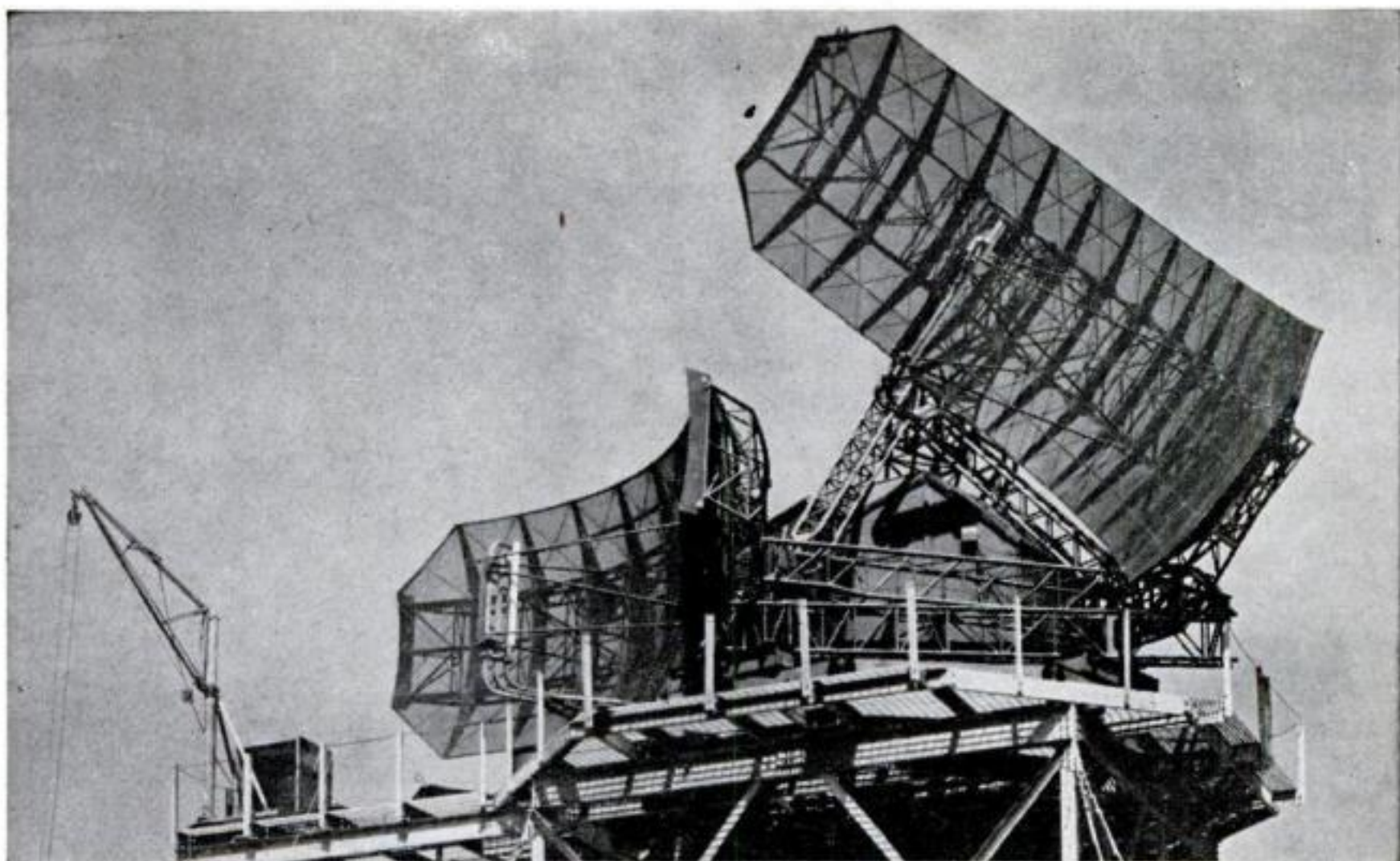
Another field for pulse-transmitting devices lies in guided-missile control. The problem here is to feed data to a built-in radio receiver, which will guide the missile to a target. Continuous waves may be used

for this purpose, but pulse control offers the advantage of coding, so that the receiver will respond only to friendly emissions and the enemy will be unable to take over control of the missile for his own ends.

Guided-missile applications are only in the experimental stage, but another field, that of industrial controls, was already highly developed before the war and now stands to benefit by the advances of radar and allied techniques. The devices used are manifold, but their common purpose is to supply self-correcting means in industrial processing in place of imperfect manual controls.

A typical problem is automatic register control in the printing industry. One solution involves the use of a phototube that detects any misregister and promptly triggers a square-wave circuit, which in turn operates a correcting motor. One of these devices will control a large printing press at any speed between 300 and 1,000 feet a minute, and maintain register to within a thousandth of an inch at all times.

High-speed photography is also a field in which microsecond timing is required. One system uses microflash bulbs fired by a control circuit with a period of about two microseconds. This is not the lower limit: the GE General Engineering and Consulting Laboratory is reported to have a fully automatic



Radar is really a stop watch—fantastically accurate—timing the speed-of-light race of a microsecond pulse from antenna to target and

back. Computers then turn travel time into distance to target. The 17-ton antenna above searches thunderstorms over 250-mile range.

camera, with a speed of one microsecond, which produces a finished transparency within 30 seconds; the Navy has another type, utilizing a Kerr cell as the shutter, for which a speed of 0.04 microsecond is claimed.

In the development of the atomic bomb, X-ray photographs were made using high-voltage pulses to create peak currents as high as 2,000 amperes, but lasting only a microsecond or so. These devices are used for observation of machinery in motion, the passage of bullets through gun barrels, and for the study of motion that can be recorded only by microsecond techniques.

Particle accelerators used in atomic research may in one respect be considered microsecond devices. Whether the particles move in linear or closed paths, they must be kicked ahead electrically at the right intervals. At the high speeds at which they move, this normally involves microsecond timing. In the FM cyclotron, for example, the particles circle the chamber at the rate of 0.1 microsecond for a single revolution, and the timing of the accelerating impulses must be of the same order.

A final example takes us back into the field of radio communication. It is the system of multiplexing, or sending several messages simultaneously over a single circuit. Its com-

plexity is one of its advantages. In military use, for which it was originally developed, it affords a high order of security precisely because it involves a complex interlacing of pulses on which it is difficult to eavesdrop.

The underlying principle, however, is simple. Even the shortest single sound of speech or music is comparatively long. It lasts for thousands of microseconds. Why, then, once we have learned how to divide time into microsecond slices, must we send all of a given sound over a circuit on which time represents money?

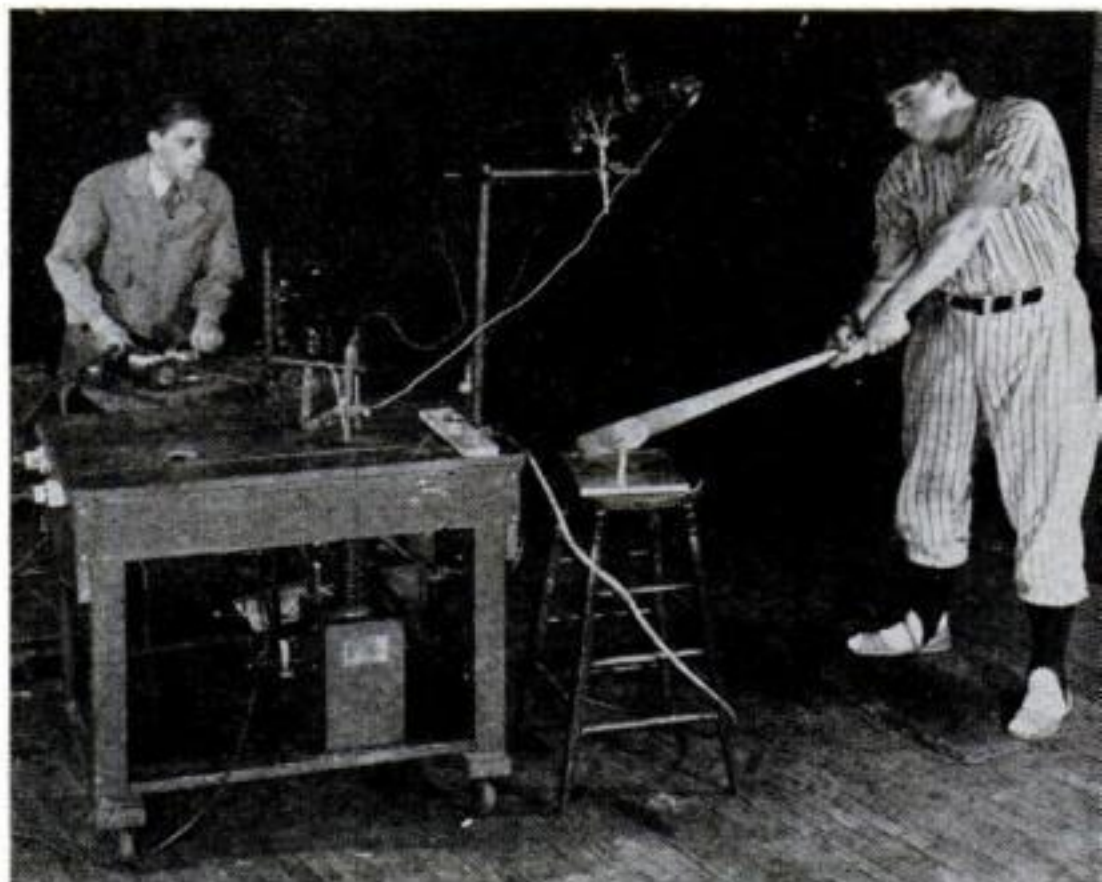
Sampling Sections of Sound

All we need to do is to listen to small sections of the sound for a fraction of a microsecond, and all the information in the original wave will be retained. Moreover, by that method we can sample a number of conversations or musical renditions and send them over the same circuit simultaneously.

The military version of this ingenious system was developed by the British, the U. S. Army Signal Corps, RCA, and Bell Telephone Laboratories. It has eight two-way telephone channels that can also serve as telegraph or facsimile channels. Bell is now using this type of equipment in several civilian installations, such as the one linking Catalina Island to the California mainland.



Radar sets need only one antenna, thanks to TR switch (above), which changes antenna from "transmit" to "receive" in a few microseconds.



Fast-action photographs, such as this one of a baseball being hit, are made with high-speed flashes lasting only about two microseconds.

A similar system developed by International Telephone and Telegraph is capable of accommodating eight broadcast channels on a single frequency, with only one transmitting and one receiving antenna. Such microsecond technique may provide economical radio reception in hotels and institutions.

How do they split seconds into a million or more pieces? For transmission and control it is done by means of pulse-generating circuits. Some of these generate square or peaked waves directly, while others start with a standard vacuum-tube oscillator producing the conventional sine wave and distort it into a series of square-shaped pulses. This is done by overloading the tubes, and is called the *brute-force* method. Using crystal-control, such circuits can be stabilized with microsecond accuracy.

For reception and measurement, cathode-ray oscilloscopes are used. In a cathode-ray tube electrons fly out of the cathode and are focused into a beam that makes a spot of light on a fluorescent screen. Deflecting apparatus in the throat bends the beam when a suitable voltage is applied. Amplitude (voltage or current) is represented on the face of the tube by vertical distances, time by horizontal distances. The voltage that produces the horizontal movement is called a *time base* and the circuit that produces the voltage is called a *sweep circuit*. A cathode-ray 'scope may have a sweep of 20 inches per microsecond.

Accuracy depends largely on the fre-



Microsecond X-rays have been developed at the Westinghouse Research Laboratories. Notice metal eyelets and nails in the kicker's shoe.

quency standards available. The Bureau of Standards has a number of transmitters constantly on the air to provide a check. Its primary frequency standards are accurate to better than one part in ten million. Its broadcast time signals are constantly compared with absolute time data from the U. S. Naval Observatory. Some of its equipment will measure a rate of change equivalent to one second in 50 years. This remarkable accuracy can be plucked out of the air for nothing.

END



Pontiac Gets "New Look"

LOOKING longer and lower than its predecessors, the 1948 Pontiac not only rivals its higher-priced cousins in appearance but is the first low-priced car to offer an automatic transmission. Long available only on Oldsmobile and Cadillac, General Motors' Hydra-Matic [®] transmission is now provided as optional equipment. New styling, as shown on the convertible above, creates an appearance of increased length and width.



Hot Dogs Hitch a Ride

IF YOU get hungry on long auto trips, here's an electric hot dog roaster that you can take right along with you. A narrow, aluminum-alloy tube with a loading tray at one end, it operates off the car battery and cooks two frankfurters, laid end to end, in three to five minutes. For home use, a 115-volt AC-DC model is also available. Called the Hot Dog Sizzler, it is made by the Thomas Manufacturing Co., of Chicago.

Spare Wheel Fits Rim

HERE'S one "fifth wheel" that would always be welcome. If you get a flat tire on some lonely road or in bad weather, just clamp the two half-sections of this emergency spare on the rim of the disabled wheel and bolt them together, as shown at right, and you can be on your way without having to change the tire. Made of heavy aluminum alloy ringed with hard rubber, the device weighs only 8½ pounds, yet is said to permit speeds up to 40 m.p.h. and to support 7,500 pounds. It is made by P. A. Special Merchandise Co., Long Island City, N. Y.



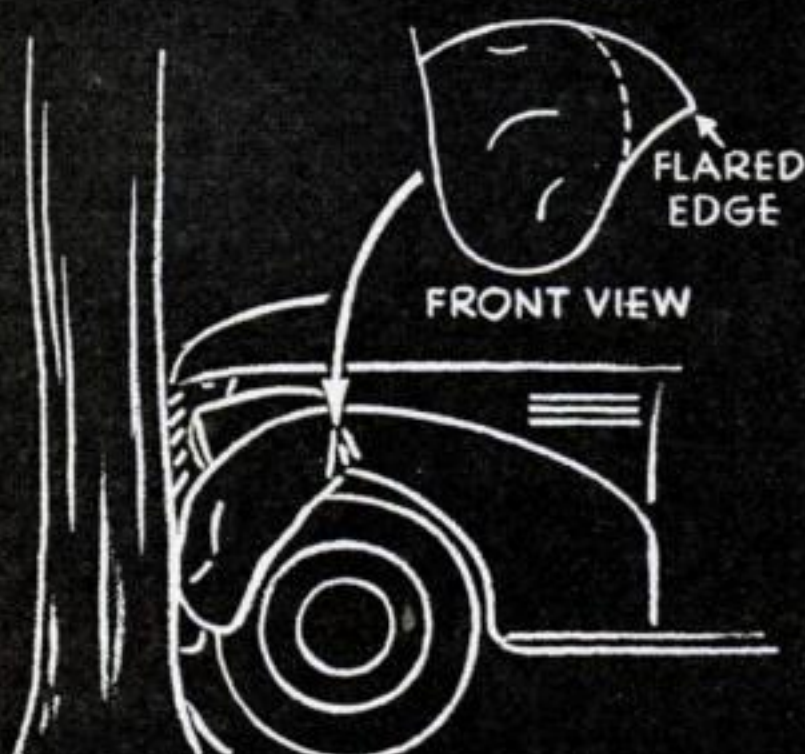
Pass Light Aids Safety



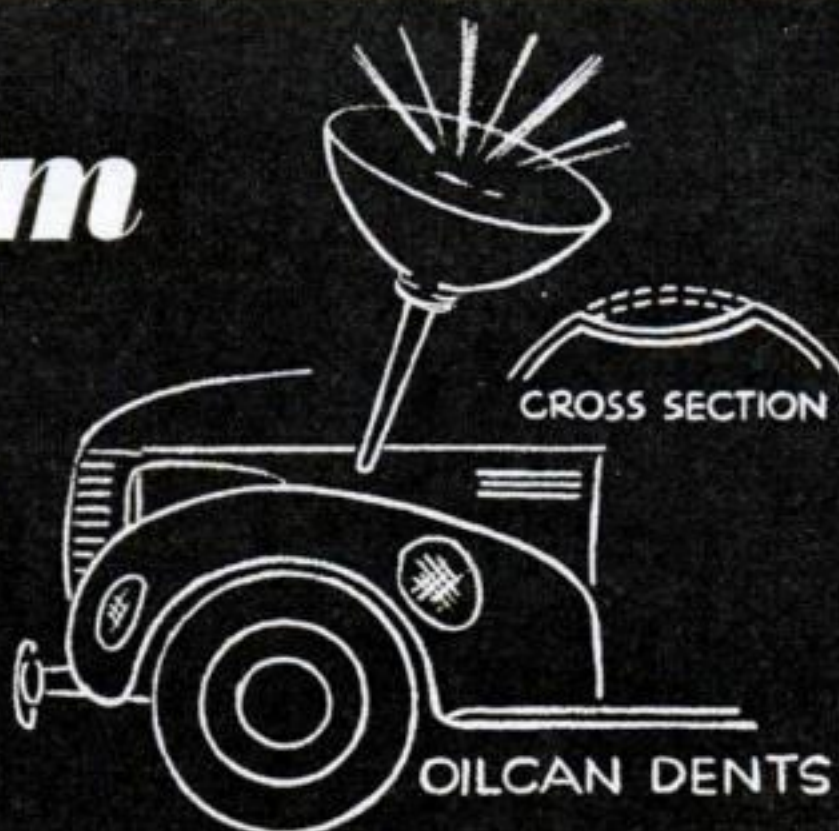
THIS accessory light for the rear of an auto takes the guesswork out of passing. It flashes "Okay Pass" to the car behind if the road ahead is clear. Operated by a push-button, it can also be used as a warning light for cars preparing to stop. It is made by the Teleoptic Co., Racine, Wis.



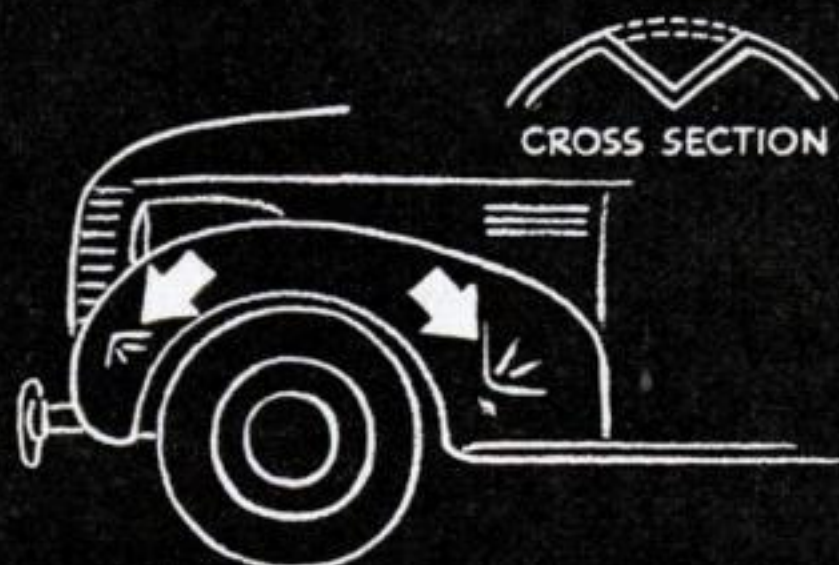
Bump 'Em Out Yourself



JAM-BACK DAMAGE



OILCAN DENTS



CROSS SECTION

SHORT, TIGHT JAMS

Are your fenders dog-eared? It's easier to iron out dents than you may think. Just common tools are needed.

By E. F. Lindsley

THERE'S a rule to remember when you're removing a dent from an automobile fender. Even more than you'd like to get rid of the dog-gone thing, the dent itself *wants* to come out. Here's why:

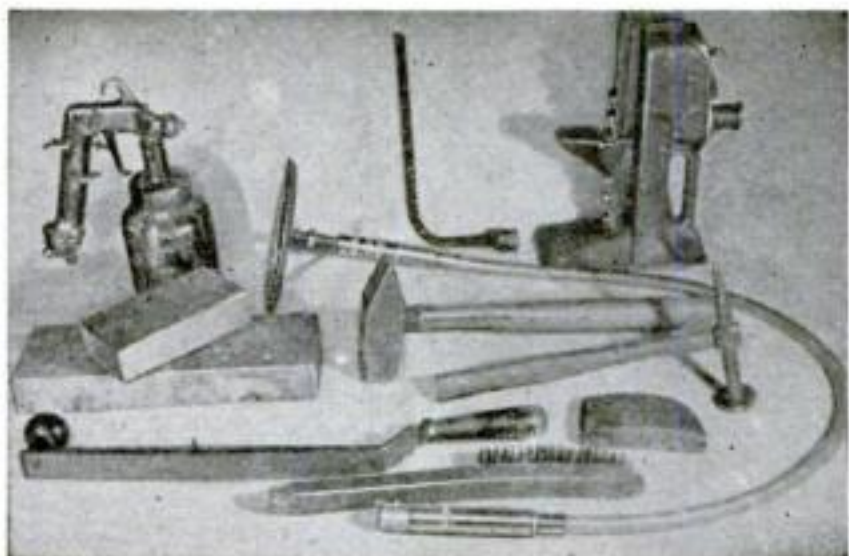
A dent is as out of place in a stamped sheet-metal part as one in a drum head, and built-in strains are constantly trying to force the metal back to its original curvature. It follows that your work should be planned to give these forces a helping hand. Metal that's badly stretched, torn, or cracked is the only exception.

Fender dents fall into three general classifications. First and most common is the oil-can or dish-shape. A type more difficult to remove is the short crease, or jam, stretched into the metal by such unyielding objects as

bumpers and lamp posts. The most troublesome is the jammed-back fender resulting from head-on impact. Here, the rolled edge of the fender shows a definite bellling out and the front part is bent back toward the wheel.

All three conditions also are found in doors, hoods, rear decks, and other locations—but such cases usually require expert attention and special tools. Stick to fenders until you've gained experience.

Step one in removing any dent is careful examination of the edge contours of the fender. Sighting along the rolled bead and comparison with an undamaged member will usually disclose irregularities in the basic alignment. Once these have been spotted, use a jack or timber to force the misalignment back towards its original curve, and use blocks as needed to hold this pressure on the metal while removing the dent. Restoration of the original pressed-in stresses makes dents come out easily. If the rolled bead at the fender edge is buckled, straighten



Few tools are needed for home fender repairs. The main ones are hammers, a jack, spray gun, vixen file, wire brush, dolly, and wood blocks. A flexible-shaft sander-polisher also is useful.



Oilcan dents usually are easily removed and often the finish is still good. Sometimes just pressing out with your hand will do the job. Place the other hand on the outside as above.



Gentle tapping along the edges with a hammer will cause a stubborn oilcan dent to pop out. Avoid heavy blows and never strike the center.



Short, tight jams take hammer work from inside and a bumping dolly against the outside. Again confine the blows to the edges.

it at least partially before going further.

At this stage, a clean oilcan dent can often be popped out by a simple push with the hand. This is a satisfying occurrence. If a pop-out seems impossible, sight along the outer fender surface at the edge of the dent. Often a very slight raising of this edge can be detected. If such is the case, tap around this raised area from the outside. In theory, at least, the tapping builds further tension in the dented area. In practice, the theory will commonly prove out by allowing the dent to be popped out.

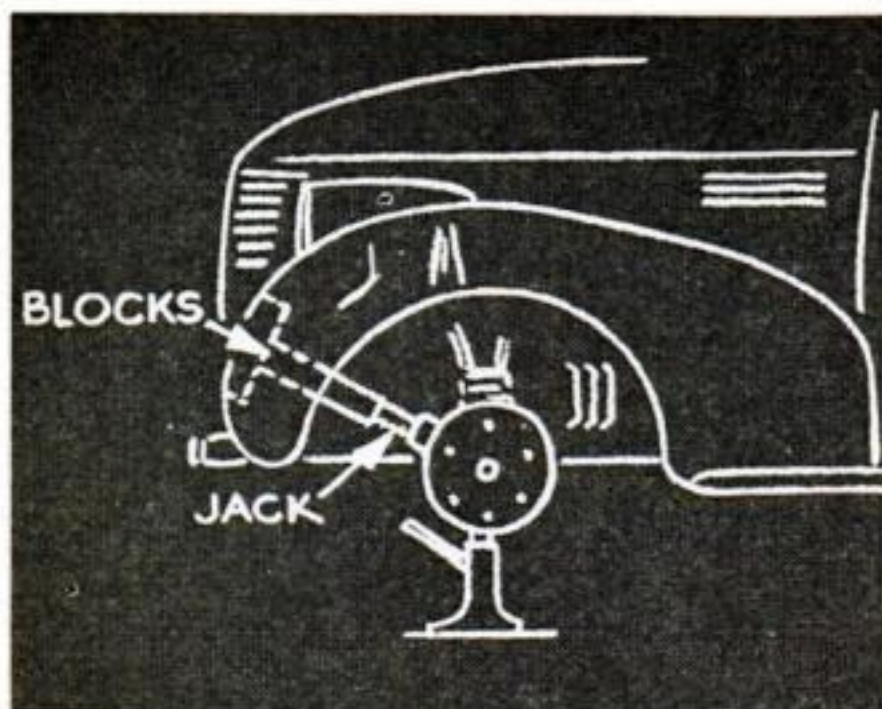
Should the depression still not yield to hand pressure, start with a light hammer, working from the inside of the fender, and tap gently around the edges of the dent. *Do not strike the dent in the middle.* Although a tempting tactic, the latter almost always results in stretched metal and a bulge in the finished job. The object of edge tapping is to reduce the sharpness of the dent edges. If this tapping is done in easy stages, the dent will either come out suddenly of its

own will, or a push with the hand will spring it back.

Once the main dent has been returned to the natural contours, a few small dimples and a slightly raised area around the edges usually remain. Ordinarily these can be cleaned up with a few well chosen blows from a light hammer. Use the backing dolly here to prevent any tendency for dents to become "warts."

The jammed-back fender usually requires the application of a jack or timber, and over-forcing is necessary to allow for the natural spring-back. The technique is one of working back and forth; force the fender partly into line, straighten edges and remove major dents, bring more pressure on the alignment jack or timber, clean up the dents a bit more, and continue until the fender holds its proper alignment without springing back.

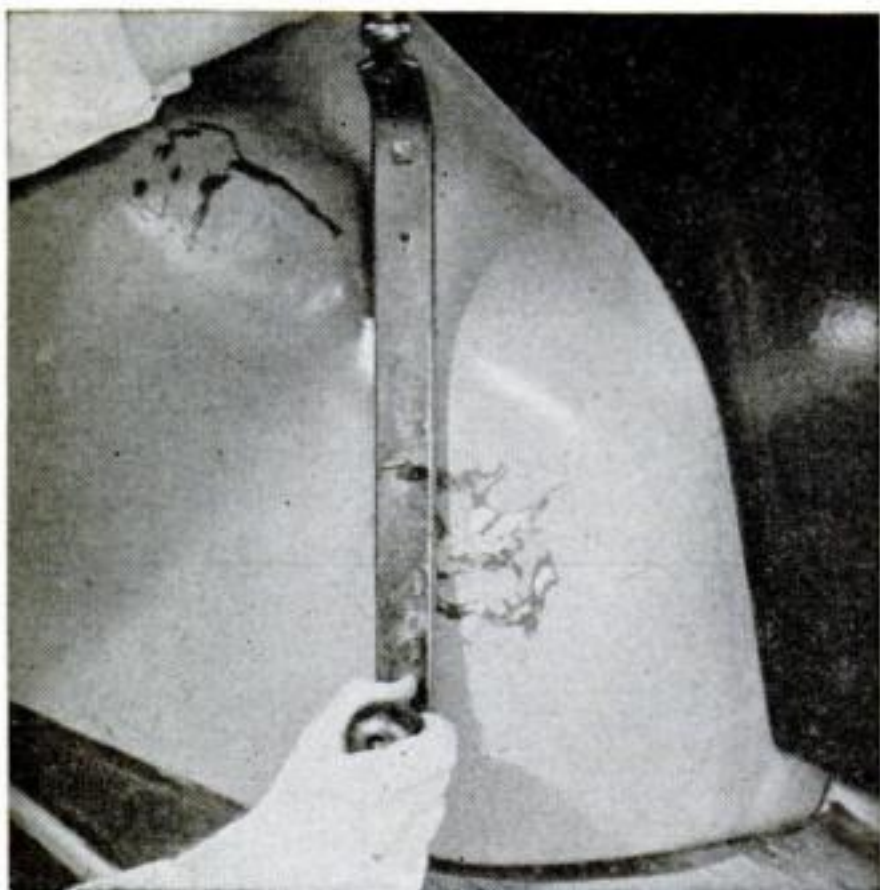
The removal of sharp, stretched depressions is often a real job. Severe metal stretching requires an acetylene torch and



Jammed fenders may be returned to position by placing a jack between padded wood blocks and a solid frame member. After normal contours are restored, clean up all minor dents.



Refinishing the dent area requires thinner, primer-surfacer, rubbing compound, sandpaper, finishing color, and masking tape. Lacquer is preferable to enamel since it dries quickly.



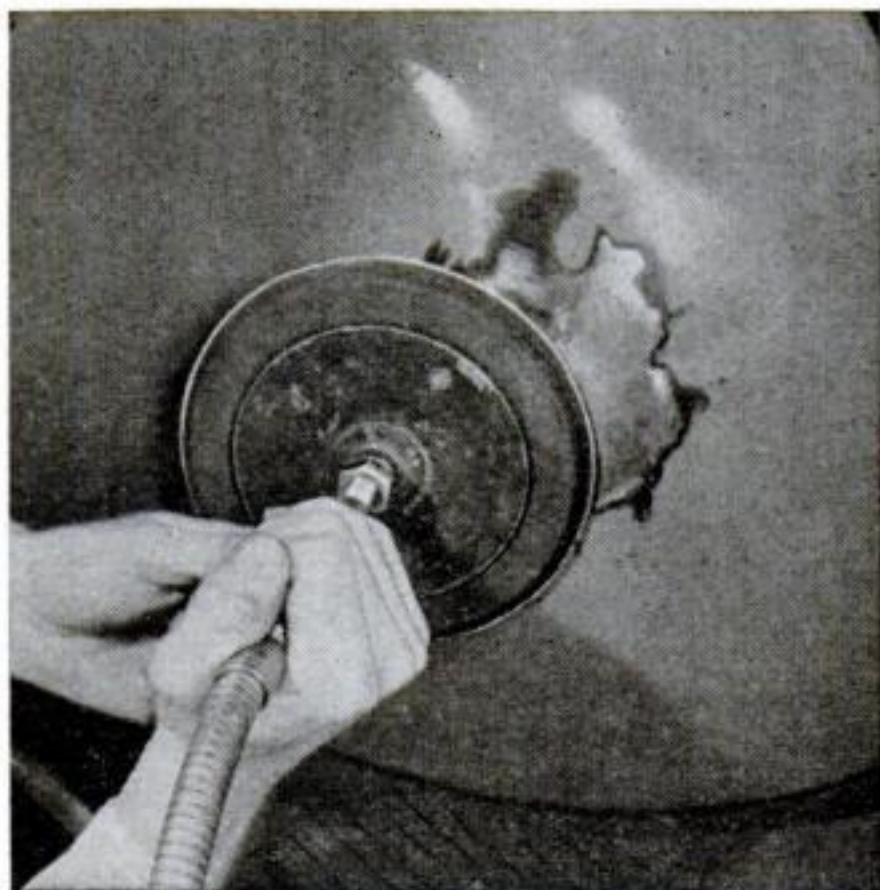
Using a vixen file in long strokes, begin to remove tool marks and feather back the old paint around the damaged area. Also clean all wax, oil, and dirt from the surface.

a metal-shrinking technique to cure it, and a repair shop is the place for such work. However, if the damage is not too serious, treat it the same as you would an oilcan dent. Begin at the edges and gradually level out the entire area to the general contour. Frequent backing of the hammer with the dolly is called for here. When a sharp dent is removed, it should be remembered that the excess, stretched metal must go somewhere. It may compress slightly, but not enough to return to its original form. Hence, it is necessary to distribute, or "blend," the extra metal over a somewhat larger radius of curvature than the original shape. If this blending is skillfully done, the ordinary eye cannot spot it.

Refinishing is essentially the same for all dents. Begin by cutting down the high spots with a vixen file. Excess filing is, of course, to be avoided. When a slight amount of cutting fails to bring the entire surface true, it is a sign that the hammering is not right and more gentle tapping is needed to bring up the low spots the file misses.

When the repaired area reveals no irregularities to the eye or fingertips, a flexible shaft and rubber-backed abrasive disk are useful for removing file marks and feathering back the old paint finish. If such equipment is not available, the worst file marks can be taken out with a mill-cut file.

In home repairs, a better job will result if the entire fender or panel is repainted. The first step is removal of old wax, oil, and



Clean up the file marks with abrasive paper and rubber polishing disk on a flexible-shaft tool. Then rub the area with wet sandpaper to get a good priming and painting surface.

dirt. Cleaning preparations made for this particular job by paint manufacturers should be used. Sanding does not remove wax satisfactorily but merely forces it into the old finish. Once the surface is clean, water-sanding with No. 320 paper is in order. Incidental scratches can be leveled down and the old paint surrounding the repair feathered back with 280 paper. Always use the finer paper over the spots sanded with 280; the coarse scratches have a way of coming through.

After sanding, clean the surface once more and avoid touching it from there on. Mask any parts in line with the overspray.

Mix a supply of primer-surfacer and spray it lightly over the repaired area and any areas that were deeply scratched. Build up successive thin layers of surfacer but at no time apply so much that it tends to run or sag. Drying time depends somewhat on the air conditions. For best results, the temperature should be around 70 deg. F. In any case the primer-surfacer should be "hard" dry before you attempt to sand it. Usually an hour or less is adequate for drying and a careful pressure with a finger nail will show if the primer is hard.

Use 320 paper and water to sand the primer to an absolutely smooth surface and to feather out the edges. Clean the surface carefully with water and examine it for imperfections. If any are found, it means that the sanding was inadequate, or, if the sanded primer is thin and bare metal shows through,

insufficient primer was applied. In the latter case, another build-up of primer is indicated.

When the car has a synthetic enamel finish, enamel may be used if a dust-free work place is available. However, lacquer is probably best for amateur finishing. It can be applied outdoors in nearly anything short of a high wind or plague of gnats, and it dries rapidly. If you don't have a spray gun, you can still get excellent results with auto enamel, paintbrush, and patience.

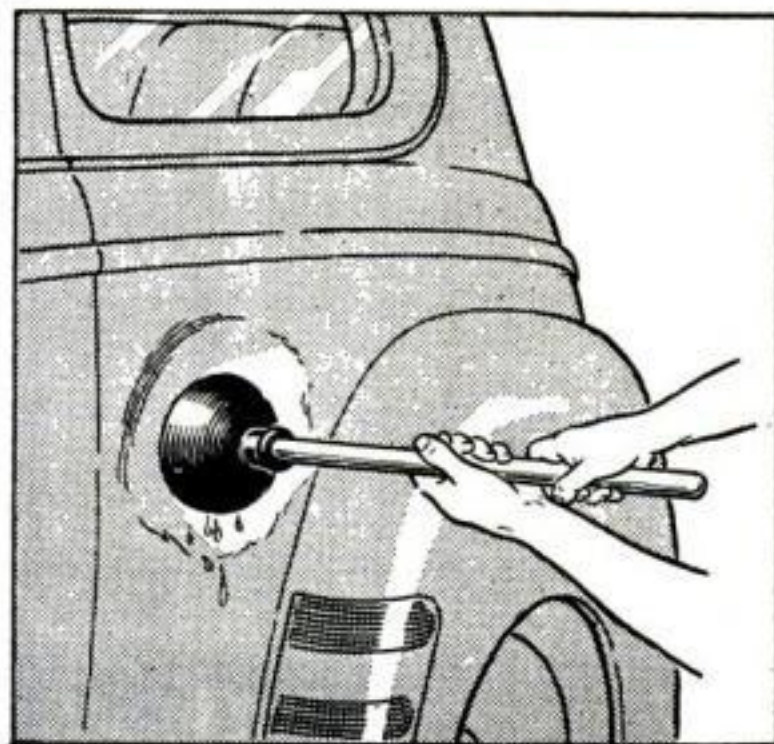
The usual spray procedure with lacquer is a thinned out mist coat—to give the following coats something to "hang" to—followed by several cross-lap coats for build. Don't be afraid to put on enough lacquer, and pay particular attention to the fender edges and projections where subsequent rubbing is likely to cut deep. Once the final spray pass has been made, clean out the gun and forget the job for at least a day.

Then examine the spray job carefully for orange peel, blemishes, runs, and other imperfections. (Orange peel is the term applied to innumerable tiny pits resembling the skin of an orange.) A surface skillfully sprayed with good equipment should need no more than a quick rubbing with compound. An amateur job may require more elbow grease. If done very gently, wet sanding with 400 or 600 paper generally will remove runs, orange peel, small dust motes, bugs, and pipe ashes.

Follow the sanding with rubbing compound, and then wax the fender. **END**



Lay a smooth surface for the finish coat by applying the primer with a spray gun. Follow the priming coat with wet sanding. You'll get a better job by refinishing the entire fender.



A sink plunger often will enable you to pop out a dent that's located in a spot you can't get behind. Dip the plunger in water first. The drawing shows how it's done.—*L. B. Wessel, Madeira, Ohio.*



Something caught Gus's eye. "What sort of mumbo-jumbo is this?" he wondered.

Gus Untangles a Double Cross

By Martin Bunn



When in-law trouble makes an outlaw of a respectable battery, there's a mixup to straighten at the Model Garage.

GUS WILSON was trying to give a finicky little speedometer repair job the 100-percent concentration it demanded, but the horn outside the Model Garage shop hooted and squawked practically continuously. After a full two minutes Gus gave up, slammed his pliers down on the workbench, and pushed the door open.

A man and a woman were getting out of the opposite front doors of a big, expensive car that had slumped into shabby old age. The man was burly, scarlet-faced, and obviously hopping mad; the woman was small, sharp-featured, and even madder.

Neither of them gave him so much as a glance. They were too busy glaring at each other. "It's driving me nuts!" the man yelled. "If that dopey brother of yours—"

"Of course, Harold dear, it's all George's fault," the woman cooed. Then her voice jumped an octave. "That's you all over, you big drip! If it wasn't for George—"

"If it wasn't for George," Harold sneered, "I'd be a lot better off. I ain't sore at him. I'm just sorry for him because he has to try to run a garage when everyone knows he ought to be in a home for the feeble-minded. Why, that—"

His eyes met Gus's, and his voice trailed off. The woman smiled sweetly. "Tell the man what's the matter with the car, Harold dear," she advised.

Harold dear glared at her. "I have the devil's own job getting it started—have to crank it oftener than not," he growled. "Battery must be run down again."

"Had it checked lately?" Gus asked.

"Checked?" Harold smiled balefully. "I

had it recharged two weeks ago—but my brother-in-law who did it must have—"

"I'll check it," Gus broke in. "Drive into the shop, and cut your engine."

Stan Hicks came in, and Gus told him to take up the car's floor boards. Then he got a voltmeter and tested all three of the battery's cells. "It's way down, all right."

Harold grunted. "That's what dopey George said, but this time I had sense enough not to let him monkey with it. Last time after he had recharged it, it wasn't much better than when I took it to him—and now it's next door to dead."

"It could be that you've got a defective switch that has discharged your battery," Gus told him. "Or perhaps your battery is just plain worn out and you need a new one—how long have you had it?"

"Only five months," Harold said, "and it was okay until Mrs. Smith's bright brother went to work on it."

"Never mind my bright brother!" Mrs. Smith snarled. "Tell the man why you had to have the battery recharged—because you came home plastered and forgot to turn the car's lights off after you managed to get it into the garage, and they burned all the rest of the night and half of the next day, and ran the battery down!"

"Me plastered!" Harold said in an outraged voice. "I have a couple drinks just for sociability and you say I was plastered!"

"Plastered—pifflicated—call it anything you want to!" his wife shrilled. "Why, two days later you still were seeing things—after George had recharged the battery you were afraid to drive the car because you

thought the whatd'yacallit—the ammeter—was reading the wrong way!”

“So it was!” Harold howled.

Gus switched on the lights, and watched the ammeter indicator move over to “discharge.” “Well, it’s reading right now.”

“Yes,” Harold admitted, “but that’s because the battery’s in the wrong way.”

“Huh?” Gus grunted.

“The only way George could get the ammeter to read the right way was to put the battery in backside front,” Harold explained.

How George Made It Work

Gus stared at him. Then he checked the cable connecting one of the battery terminals to the car frame. It was a little corroded, but its connections were moderately clean and tight. He put the positive terminal of his voltmeter on the post, the other across the cell, and saw the indicator move in the right direction. “The positive pole of the battery is grounded to the frame,” he told Harold. “That’s right for this model car.” The battery-terminal connections caught his eye. He examined them more closely, and saw that the smaller cable’s lug had been forced over the larger terminal, and that the larger lug had had a shim inserted in it to make it hold on the smaller terminal. “What sort of mumbo jumbo is this?” he wondered out loud.

Harold laughed gratingly. “That’s dopey George’s work,” he said. “When he had to switch the leads to make the ammeter read the right way, he did it to make ’em hold.”

Gus scratched his head. Then he looked at the shop clock and saw that it was close to four. “There’s something screwy about this,” he told Harold. “You’d better leave your car. Maybe your battery is worth recharging—do you want me to do it if I think it is?” Harold nodded assent. “All right, then—come in late tomorrow.”

The Smiths departed, still bickering noisily. Gus went back to the job they had interrupted. By the time he got back to the Smith car it was near quitting time. “Put this battery on the charger, and see what happens,” he told Stan. “It’s probably pretty near done for, but maybe there are a couple of months more service in it.”

The Double Cross

Gus was plenty busy the next day—so busy that it was along toward three o’clock before he thought of the Smith job. “How

about that battery I told you to put on the charger?” he called to Stan.

“It’s okay, I guess,” Stan reported. “It took a charge.”

“Good enough,” Gus said. “Put it back and call me when you’ve got it hooked up.”

Ten minutes later Stan called him. Gus got into the car and pressed the starting button. The starter had a good kick to it, and the engine took off promptly. Gus speeded it up, and watched the ammeter.

The indicator moved over into the “discharge” division of the scale!

“Hey!” Gus yelled. “How the heck did you hook up this battery?”

“Just exactly the same way it was hooked up before I took it out,” Stan told him in an injured voice.

Gus switched off the engine and then switched on the lights.

The indicator moved into the “charge” division of the scale!

Gus turned off the lights, and sat thinking. Then he took up the floor boards and put his voltmeter across the end cell, its positive terminal on the grounded post, just as he had the day before. The indicator jerked below the scale. He put the same meter terminal on the post at the other end cell. The needle moved the right way.

Gus laughed, and rapped the side of his head hard with his knuckles. “The old bean sure is slowing down,” he told his puzzled helper. “Switch the battery around.”

When Is a Positive Not a Positive?

“Okay,” Stan said obediently. “But I don’t get any part of this, boss. Yesterday the ammeter read the right way. I hooked the battery up just the same way today—and now the ammeter reads the wrong way. And yesterday when you checked the battery pole that’s grounded to the frame it was positive—and today it’s negative. But I don’t see what I did wrong.”

Gus gave him a friendly poke in the ribs. “The only thing you did wrong,” he said, “was charge the battery right. . . . I’ll tell you about it afterwards.”

Stan reversed the battery in the car. Then Gus checked the job. With the lights off and the engine on, the ammeter indicator moved into the “charge” division of the scale; with the engine off and the lights on, it moved into the “discharge” division.

“Okay,” Gus said. “And just in time. Here come the Smiths—still scrapping!”

And still scrapping they drove out in the

car. While Gus was washing up later that afternoon he noticed that Stan was very busy making diagrams with a red and black pencil. "Hey, kid," he reminded him, "It's time to go home."

"Yeah," Stan muttered absently. "I've been tryin' to dope out about that battery. You said you'd tell me about it, but—"

Uncrossing the Double Cross

"Sure I'll tell you about it," Gus said. "It's not so tough if you start at the beginning—which was when our friend Harold got plastered and ran his battery down by leaving his lights on for several hours. Well, he took it over to his brother-in-law George, who put the battery on the charger the wrong way—with the charger's positive lead connected to the battery's negative pole."

"Gosh!" Stan gasped. "What would you do to me if I ever did that, boss?"

"Shoot you, or bash your head in," Gus assured him cheerfully. "A battery treated that way isn't long for this world. . . . Well, George's charger overpowered the battery and gave it a reverse charge, which changed what had been the positive pole to the negative, and the negative pole to the positive. When he put the battery back in the car and connected it the right way, the ammeter read the wrong way. So he turned the battery around—botching up the terminals to do it—and the ammeter read the right way."

"Of course that poor misused battery didn't have much moxie, but with a little help from the hand crank it started the car—for a while. Then it gave up the ghost, and Harold brought it in here. You put it on the charger the right way—and the charger overpowered what was left of the reversed charge, changing the original positive pole back to positive, and the original negative pole back to negative."

"I hooked the positive lead of the charger up to the bigger terminal post on the battery. That's right, isn't it?"

"Sure. But when you put it back and connected it up just the way it was before you took it out, the ammeter read the wrong way again. And then when you reconnected it in the opposite way—the way it always should have been connected—the ammeter read the right way, because the battery polarity was back where it belonged. . . . Got it, kid?"

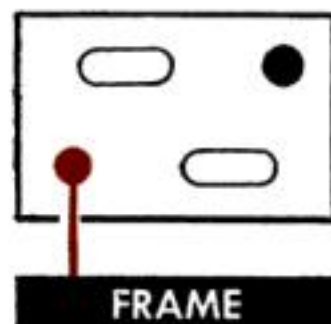
"All I got," Stan groaned, "is a heck of a headache!"

END

KEY TO THE MYSTERY OF THE TWO-FACED BATTERY

①

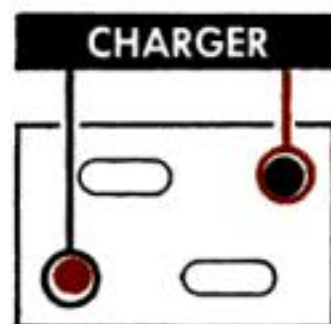
POSITIVE
POLE
GROUNDED



● NEGATIVE
● POSITIVE

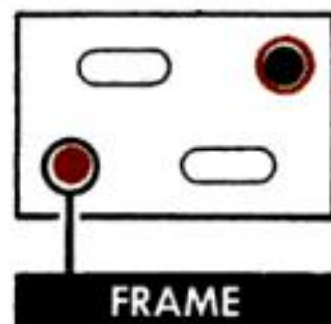
②

BATTERY
CHARGED
INCORRECTLY



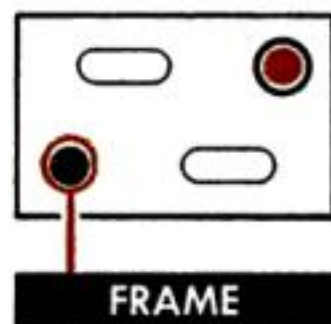
③

BATTERY
PUT IN CAR
CORRECTLY



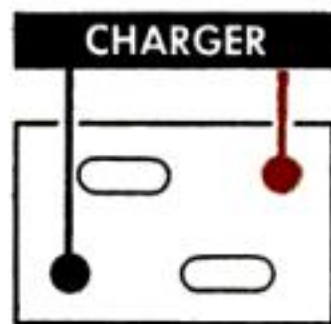
④

BATTERY
REVERSED
IN CAR



⑤

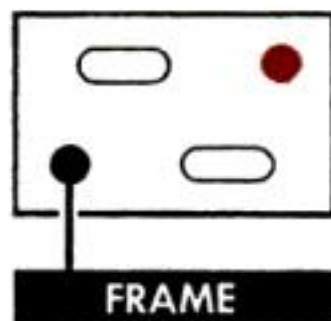
BATTERY
RECHARGED
PROPERLY



ORIGINAL
POLARITY
RESTORED

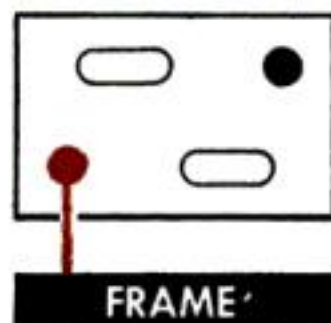
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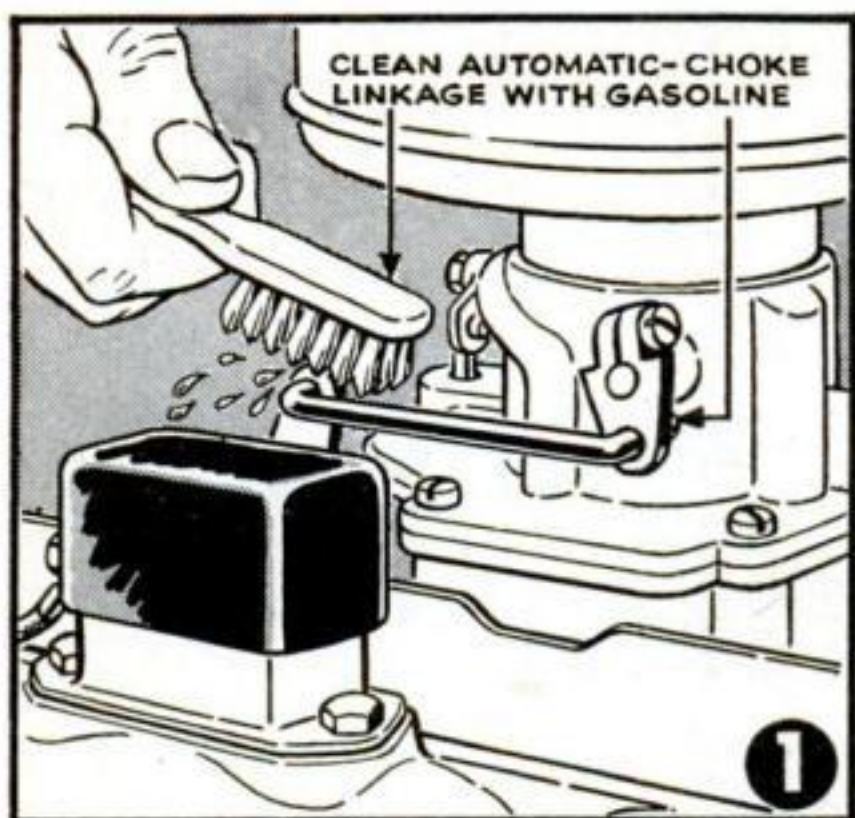
BATTERY
REPLACED
AS IN FIG. 4



⑦

BATTERY
PUT IN CAR
CORRECTLY





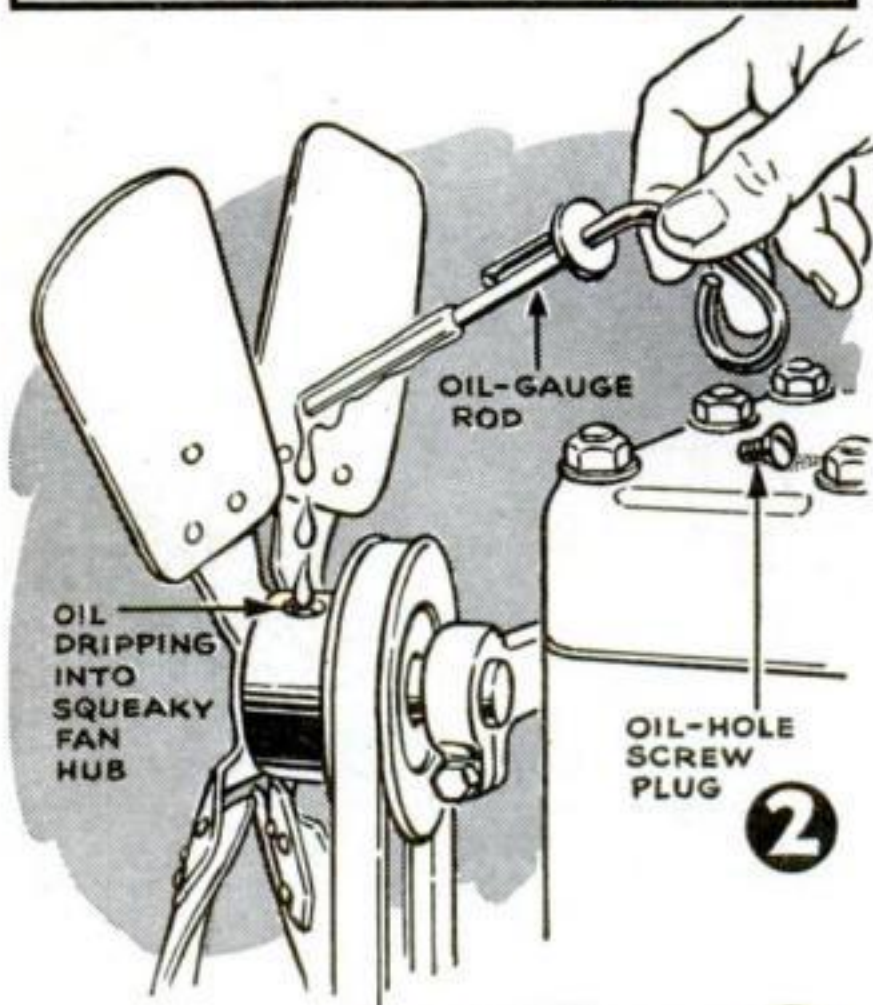
Hints From the



1. Automatic chokes

sometimes get blamed unfairly. Here at the Model Garage we've learned to look first at the linkage between the carburetor and choke-control mechanism. Oil on the connecting lever will gum it up

and make the choke sluggish. A toothbrush dipped in gasoline removes oil and dirt; very often that's all that is needed.

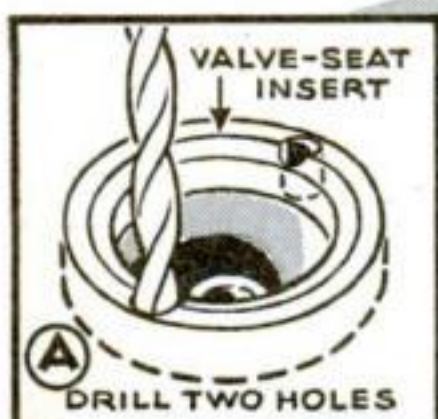


2. Fan Squeak Gives Warning.

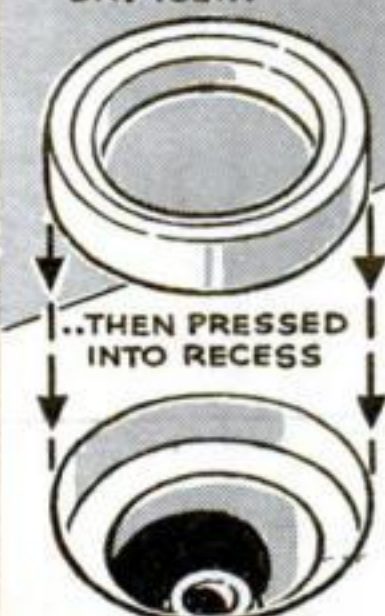
Many fans start to squeak when lubrication is neglected, and a scored shaft is never far behind. Marion L. Rhodes, of Knightstown, Ind., heard the warning noise, but he was on the road, had no oil can, and was miles from a service station. To forestall trouble, he removed the screw plug and held the oil dip stick over the opening.

3. Freeze a New Insert Ring.

If valve inserts are being replaced and don't come out easily, remove with a drill and chisel, taking care not to damage the recess. Pack new rings in dry ice for at least 15 minutes to shrink them.



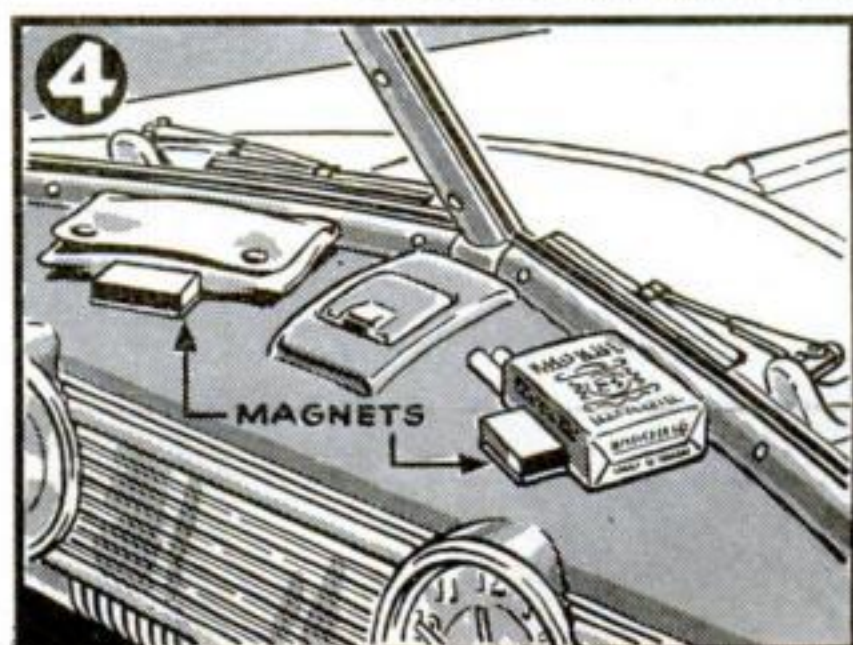
C NEW VALVE-SEAT INSERT IS CHILLED AND SHRUNK WITH DRY ICE...



4. Magnets Peg Things to Dash.

Cigarettes, sun glasses, and the like are always in reach for William G. Hykle, Montreal, who uses magnets to hold them up against the windshield frame on his car's sloping dashboard. Felt glued under each magnet keeps it from scratching.

Drawings by Stewart Rouse



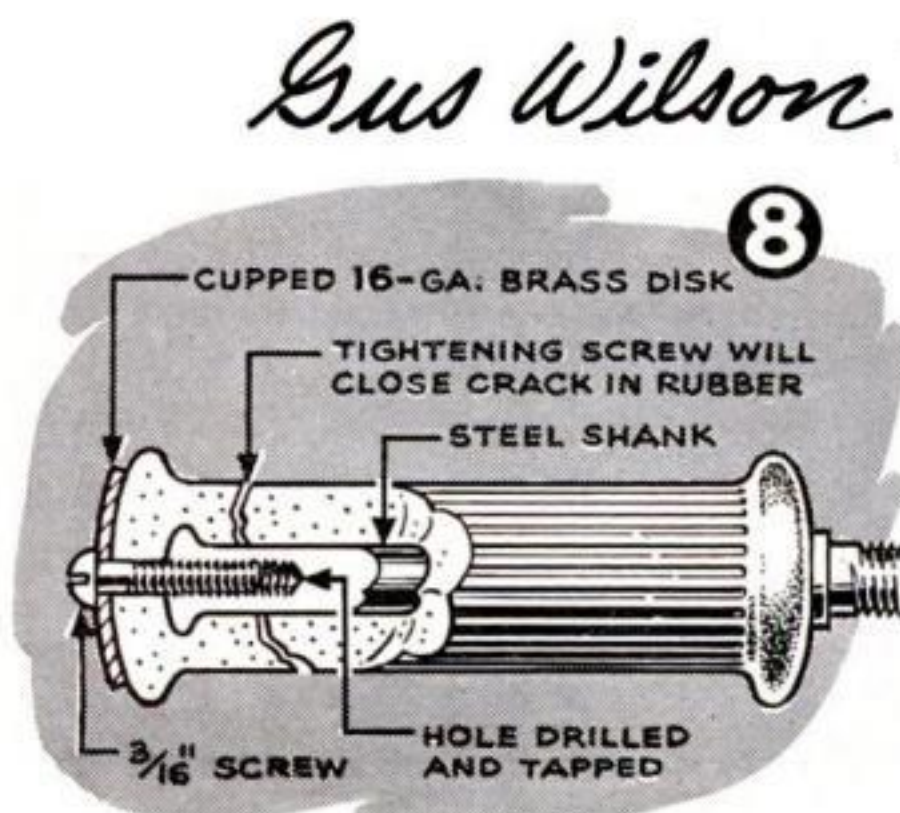
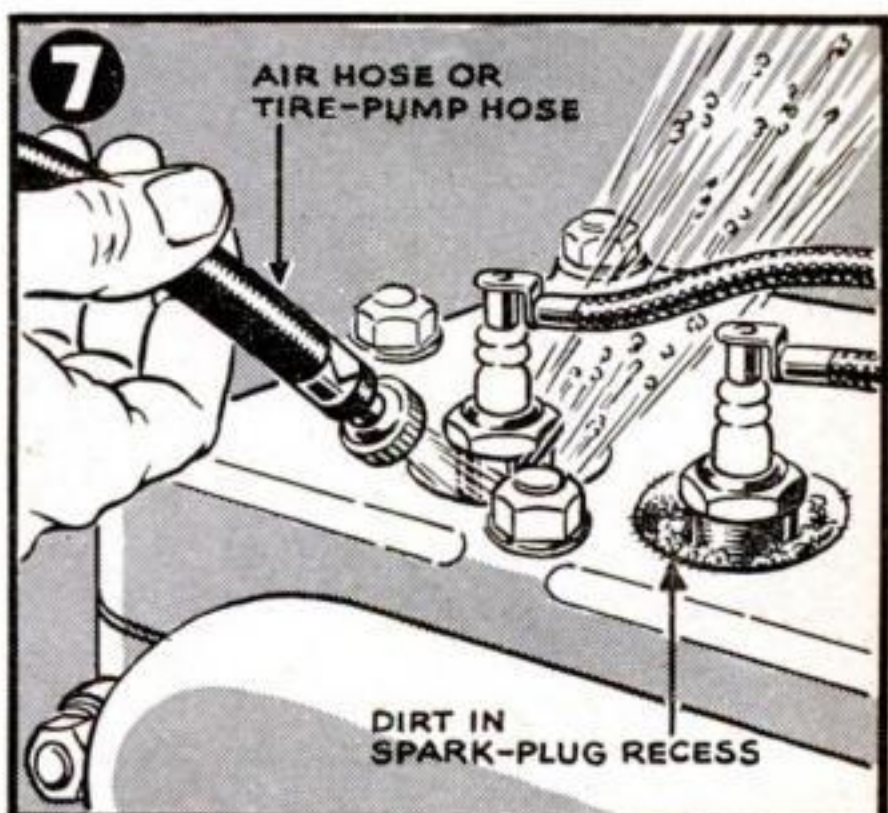
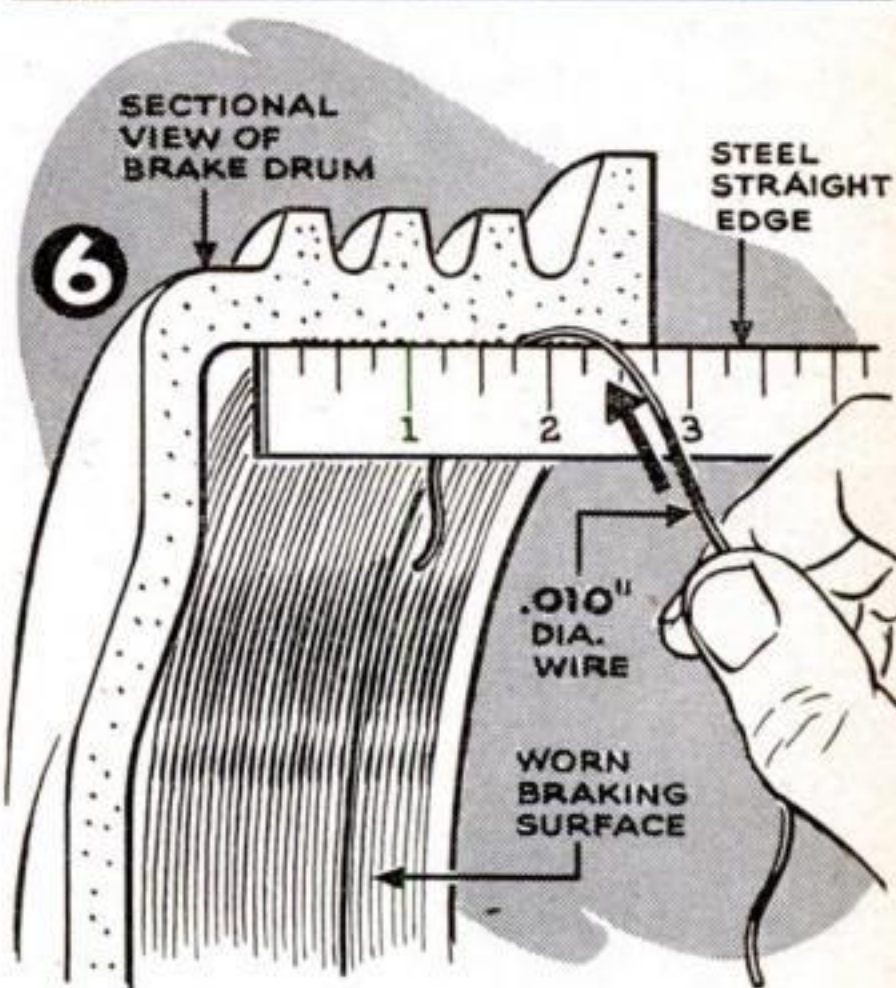
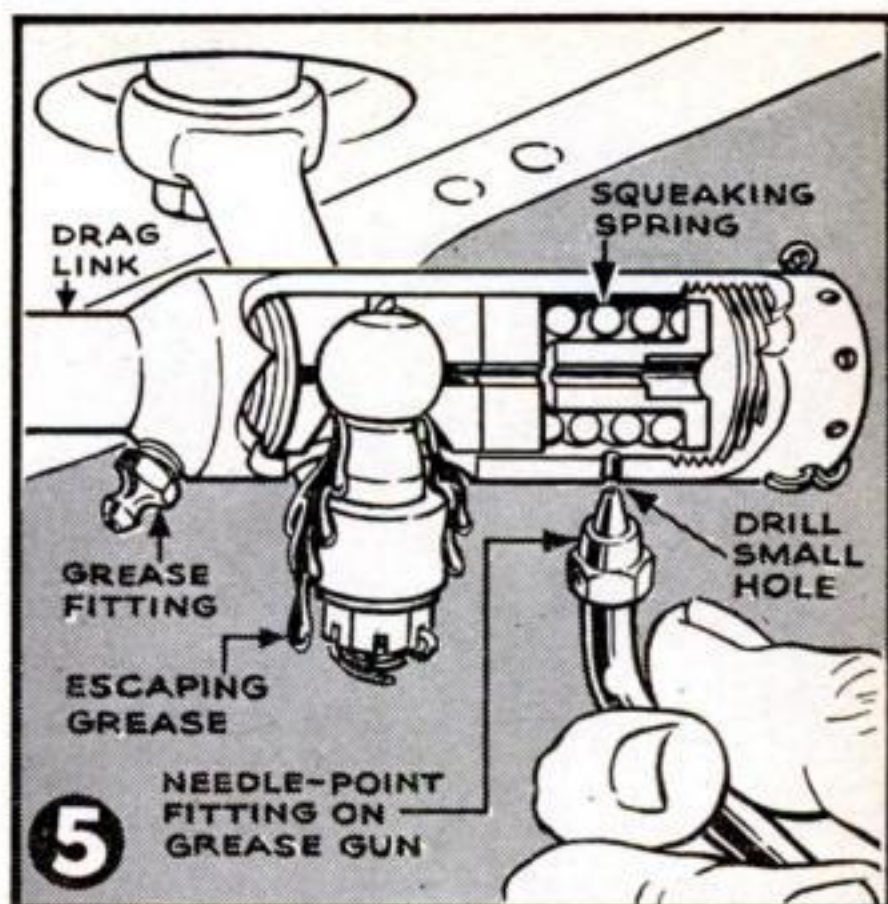
Model Garage

5. Grease Stops Squeak. A persistent squeak when you turn the steering wheel may come from the spring-cushioned end of a drag link that hasn't been lubricated properly because the grease didn't reach the spring. The squeak can be stopped by drilling a tiny hole in the housing and forcing grease directly to the spring.

6. Gauging Brake-Drum Wear. John Krill, of North Lima, Ohio, reports that one truck-fleet superintendent uses a straightedge and .010" wire to determine if brake-drum scoring is bad enough to demand machining. If the wire passes through any groove, the surface is considered in need of refinishing.

7. Blow Out the Dirt. One thing you'll never see in the Model Garage is a mechanic grab a wrench and remove a plug without preliminaries. Dirt should first be blown from the seat with an air hose—or failing that, a tire pump.

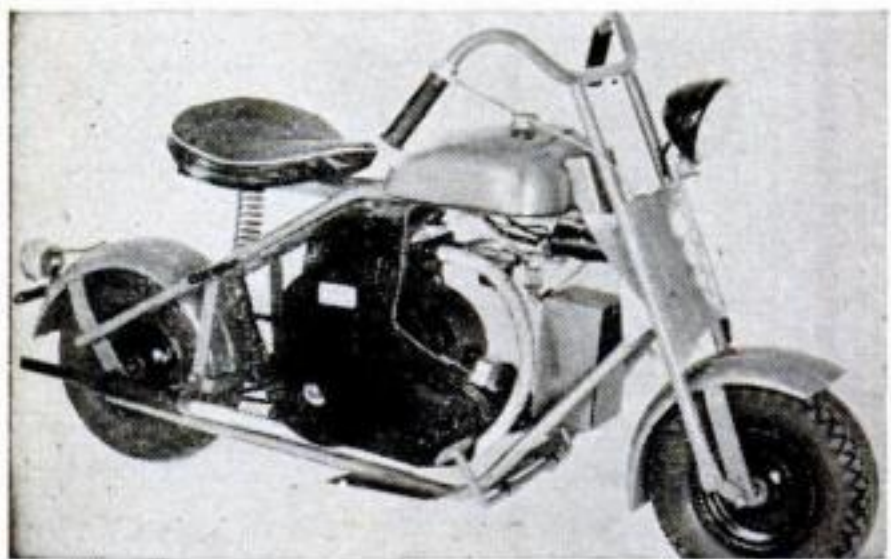
8. Cycle Footrest Repaired. If a crack occurs in the rubber casing of a motorcycle footrest bar, cut a disk out of 16-ga. brass, cup with a ballpeen hammer to conform to the casing, and drill the disk and shank for a 3/16" screw. Turning up the screw will close the crack. I. J. Stretten, Detroit, makes the suggestion.





Bike Motor Has Reserve Power

DEVELOPING $3\frac{1}{4}$ hp., a new bike motor announced by Marman Products Company, of Inglewood, Calif., provides an easy cruising speed of 35 m.p.h. without strain, leaving ample reserve power and speed for emergencies. Designed for standard balloon tire bicycles, the twin-cylinder, two-cycle engine is of the horizontally opposed type, and a multiple plate dry disk clutch provides smooth starts without belt wear. In tests, it has given more than 100 miles on a gallon of gasoline.



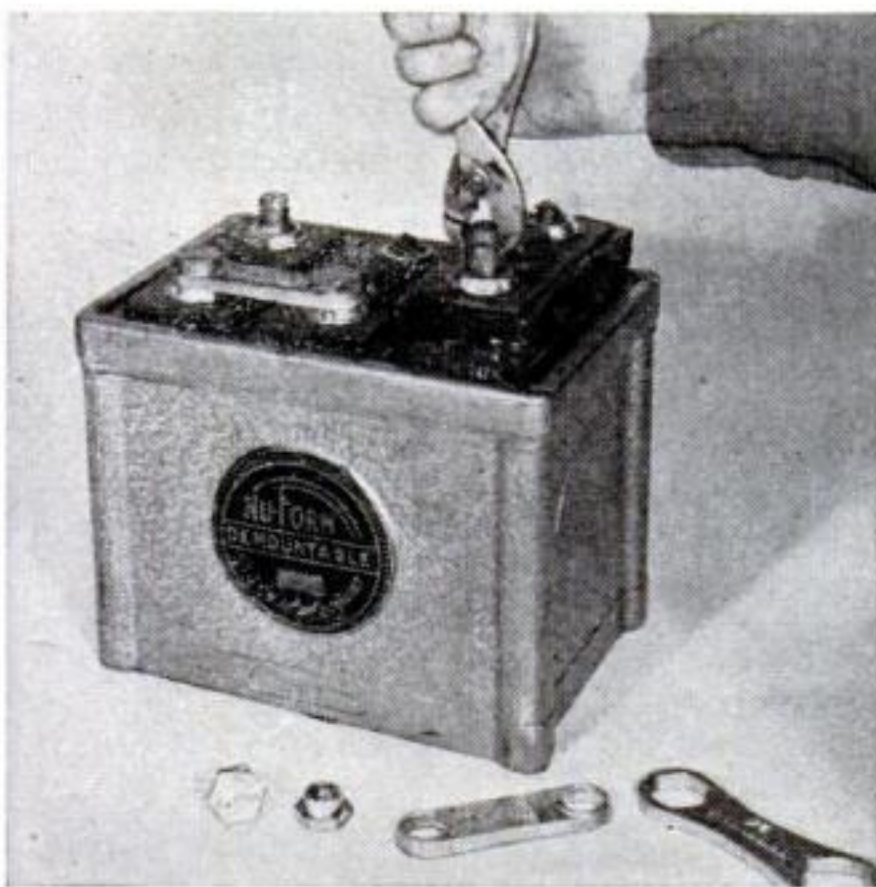
New Scooter Uses Auto Parts

PROVIDING speeds up to 60 m.p.h., this new 250-lb. scooter is said to give 70 miles per gallon of gasoline. The single-cylinder, four-cycle engine is air cooled, has a piston displacement of 21 cu. in., develops 8 hp., and was designed around automobile parts—pistons, valves, valve keepers, piston rings, coil, generator, etc.—available at automotive supply houses. Built on a 51" wheelbase, the scooter is 70" long with a saddle height of 25". Clark Engineering Co., South Pasadena, Calif., makes it.



Chevrolet Improves Bearings

CRANK-ARM thickness in the 1948 Chevrolet models has been increased for greater durability, the crankshaft itself has been made more rigid, and new interchangeable main bearings with thin-wall babbitt are expected to have more than double the life span of earlier bearings. Connecting-rod bearings also are of long-life type. Styling changes include a T-shaped, chrome center bar on the grille, as seen above.



Battery Easily Taken Apart

SHOULD any of the inner components of this battery wear out, they may be quickly replaced in the home garage, for the battery is designed for easy disassembly with only a pair of pliers. Plates are hung from the covers of the cells, a feature that is said to prevent damage from the shock and vibration that may occur when they rest on the bottom. The manufacturer, the Associated Battery Assemblers, of Los Angeles, also claims that the construction eliminates corrosion around the terminals.

Mechanics and Handicraft

REG. U. S. PAT. OFF.

<i>Binding Your Magazines</i>	PAGE 230
<i>Squaring Stock with Power Tools</i>	PAGE 192
<i>Three-Way Outdoor Fireplace</i>	PAGE 196
<i>Small Milling Machine</i>	PAGE 209
<i>Superhet a Beginner Can Build</i>	PAGE 222



Simple bookbinding puts
your favorite magazines
in hard covers. Page 230.



Man's Jewelry Is a Lathe Job

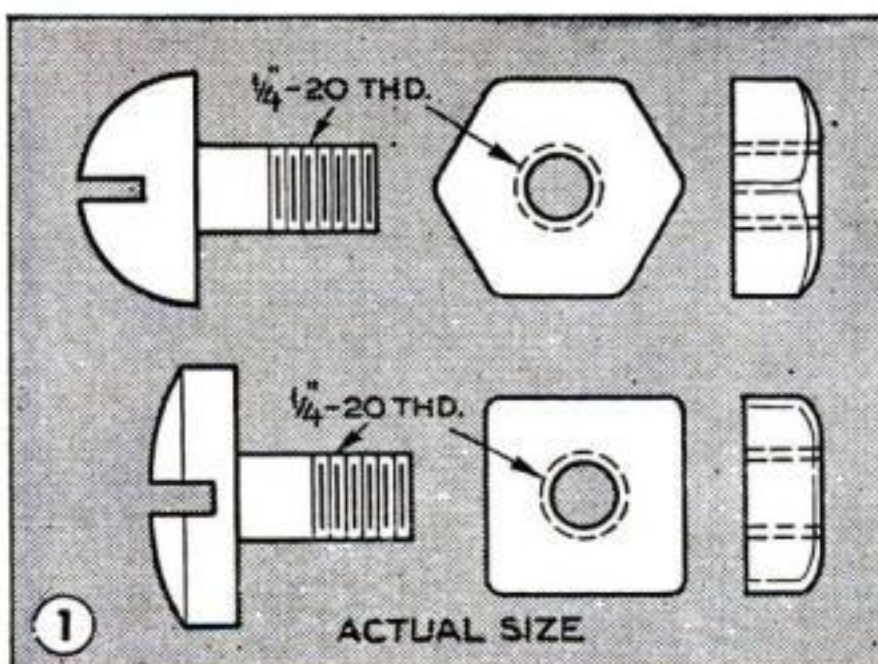
RUGGED, attractive cuff links that reflect the personality and craftsmanship of their wearer can be turned on a small lathe from plastic or stainless steel. These materials, which will not mark the skin, also make practical collar buttons.

The links shown on this page (Fig. 1) are actually massive bolts and nuts turned from plastic. Dimensions are not critical and could be copied from a real bolt and nut of appropriate size. To vary the design, the bolthead might be made in square or hexagonal shape, matching the nut.

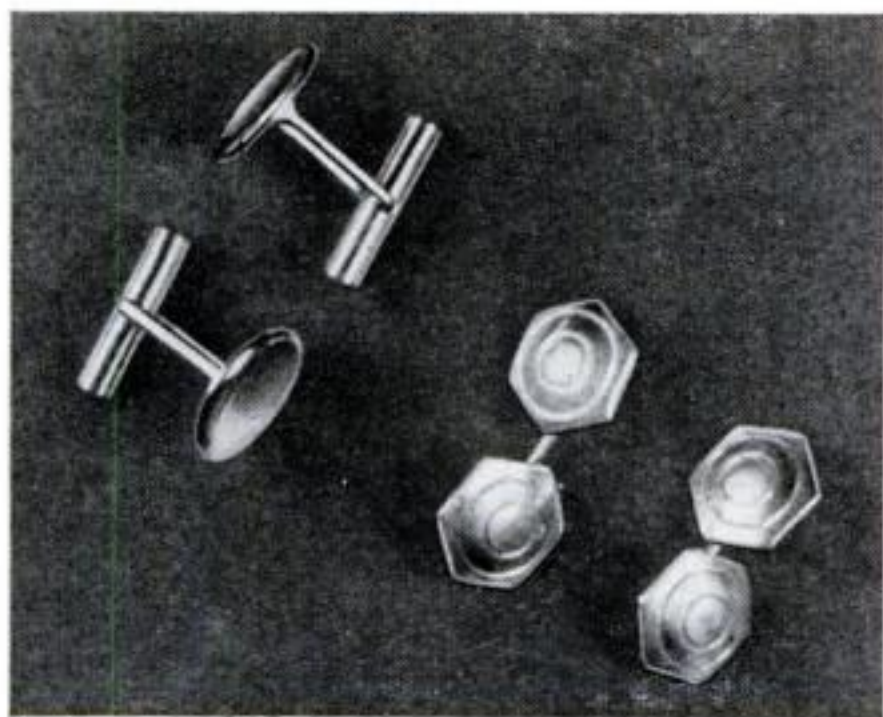
Square or hexagonal stock, if available, simplifies the work. With it you need only chuck the stock, turn the bolt shank, thread with a die, and part off, forming the chamfer on the head with a file before the piece

is cut free. If round stock is used, chuck a short length and turn and thread the bolt shank. Cut off, leaving enough stock for the head, reverse in the lathe, and form the head. For a square or hex bolt from round stock, remove from the lathe and file the head to shape. If you are copying a real nut or bolt, clamp it in the vise alongside the plastic piece and simply file across the flats until they coincide with those of the metal one.

Cut the screw slot across the bolthead with two hacksaw blades clamped side by side, being careful to cut on a diameter and to keep the sides straight. The threads on the bolt shank should run only $\frac{1}{4}$ " in from the end. Turn a nut on until it binds, file the shank flush, and polish all over. Stock



Jet black or clear plastic, turned on a lathe, produces these unusual nut-and-bolt cuff links.



These two link sets, made of stainless steel, were designed by Joseph F. Gréce, of New York.

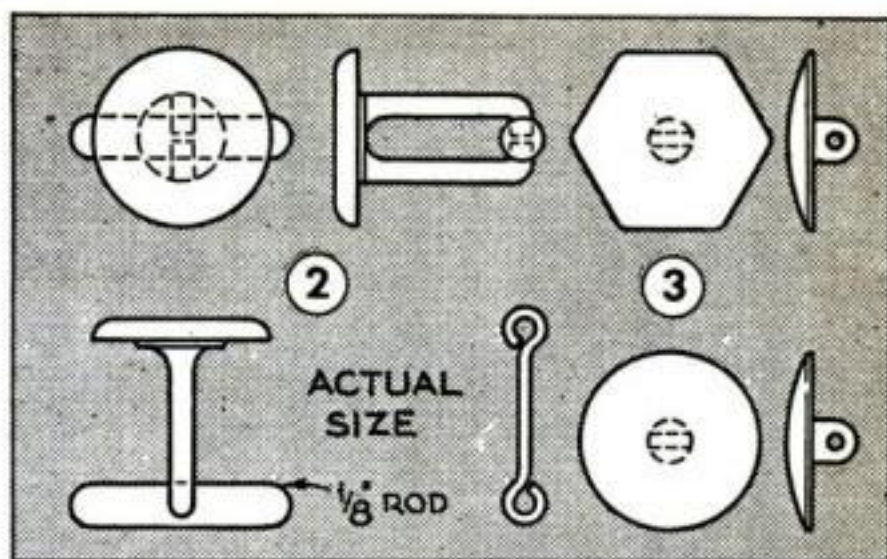
for the nuts is drilled, tapped, and cut off for filing to shape.

More intricate cuff links can be made of stainless steel, a material increasingly popular with jewelry makers. It polishes to a bright, silvery luster, and resists scratching and corrosion. The design shown in Fig. 2 is turned from $\frac{1}{2}$ " rod. Turn a $\frac{1}{4}$ " shank $\frac{1}{2}$ " long and cut off, leaving a $\frac{1}{16}$ " head. Reverse the blank in the lathe, round the edges, and smooth the face with a file and emery cloth. Place the shank in a vise and file a flat. Scribe a center line, center punch, and drill three $\frac{1}{8}$ " holes. Then file the other side of the shank flat. Use needle files to remove the excess material left after drilling, forming an oblong slot in the shank. Slit the end of the shank with a jeweler's saw, and round the corners.

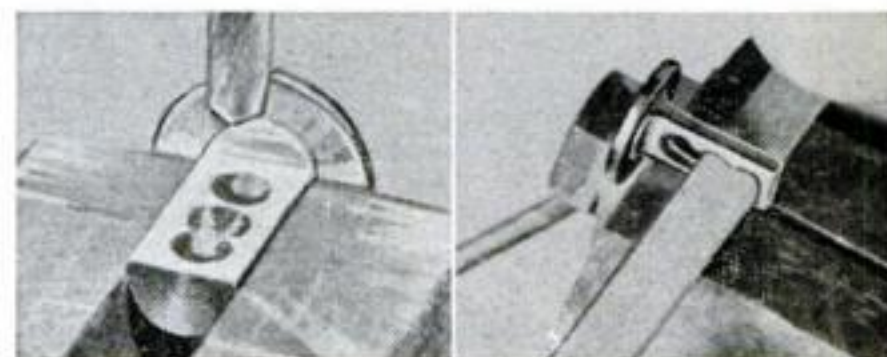
The crosspiece is a short length of $\frac{1}{8}$ " stainless-steel rod, drilled at the center. To attach it, wedge the sides of the shank apart and slip it into position. Then tap the shank sides gently with a light hammer to lock the crosspiece in place. Finally, buff the flat end surface.

Another style link that uses two "buttons" connected by wire (Fig. 3) is made in much the same way as the links of Fig. 2. It requires twice as many buttons, however, has shanks only $\frac{1}{8}$ " by $\frac{1}{8}$ ", and is filed to a greater curve. If desired, the buttons can be decorated with circles by bringing a sharp-pointed lathe tool against the face.

Stainless steel and plastic are both suitable for collar buttons. Chuck a piece of $\frac{1}{2}$ " rod and reduce it $\frac{1}{4}$ " for the length of the button height. Then further reduce to form the stem behind the head, and cut off, leaving a thin shoulder or flange to form



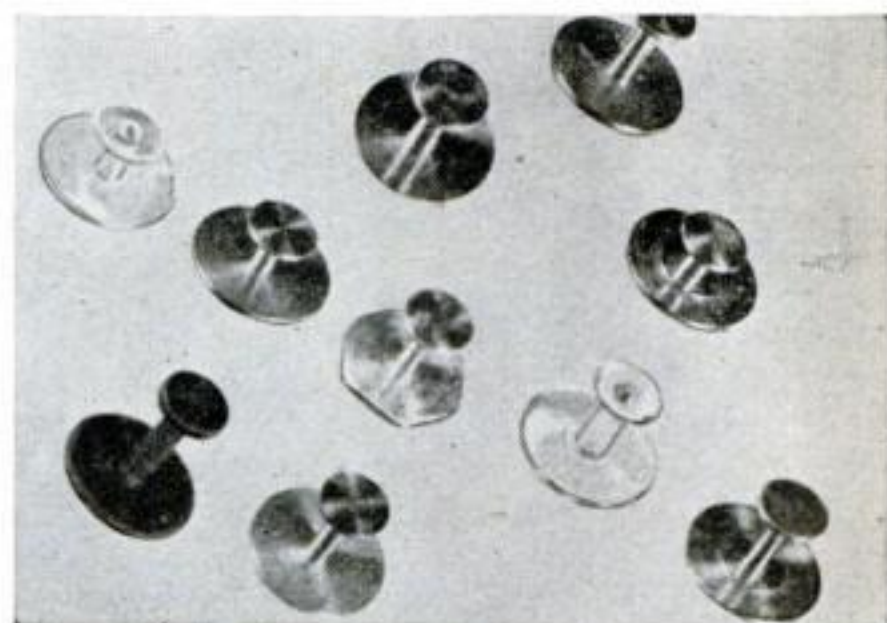
A blank for the link shown in Fig. 2 (top) is cut off after the shank has been reduced to $\frac{1}{4}$ ".



Three holes are drilled through a flat filed on the shank, and the extra metal is removed.

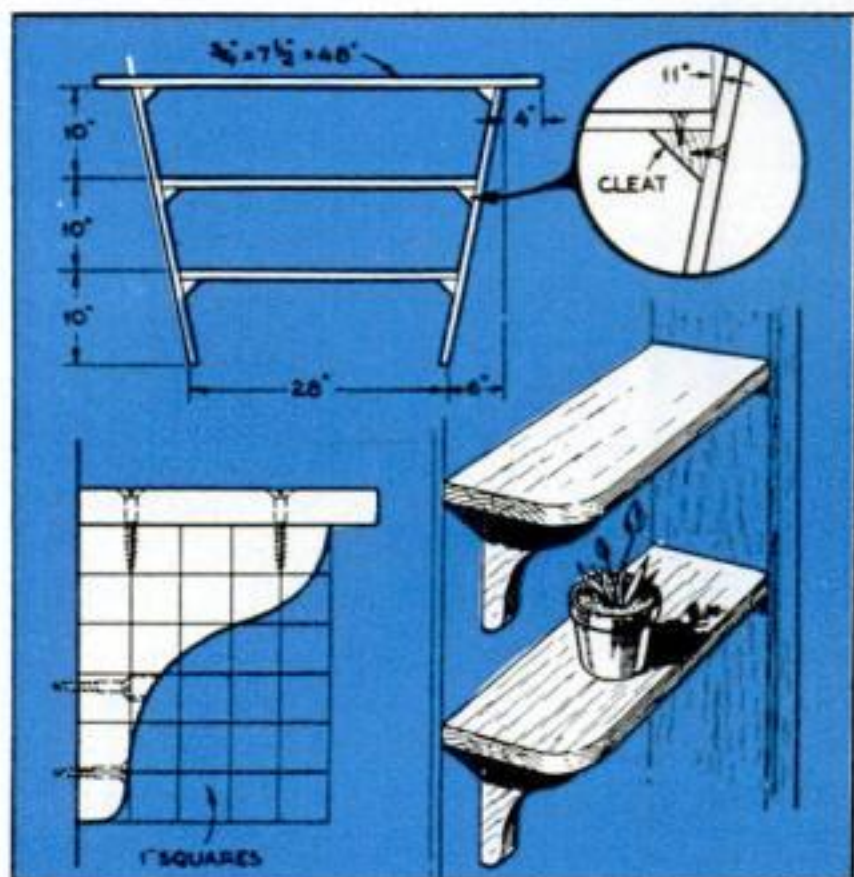
the base. Finish the base by taking it in the fingers and rubbing on a sheet of emery or crocus cloth laid face up on a flat surface.

If you plan to make many of the buttons, it may be worth while to devise a special fixture to hold them in the lathe while facing and polishing the base. It could be a piece of round stock that's bored for the head and slotted for a clamping screw.



Stainless steel and plastic are good materials for collar buttons, as they do not mark skin.

A New Slant on Flowerpot Shelves



Potted plants on neat shelves add interest to this home. Sketches at the left show how the shelves were made. All are painted white.



WHEN building a set of flowerpot shelves to go under a casement window on the terrace, the owner of a California beach home gave them a new look by putting the sidepieces at an angle instead of straight. Quickly built of stock material with butt joints as in the drawing, the unit was made rigid by screwing angled cleats under each shelf. At the same home, small shelves are supported by brackets on each side of the entry.—Hi Sibley, Nuevo, Calif.

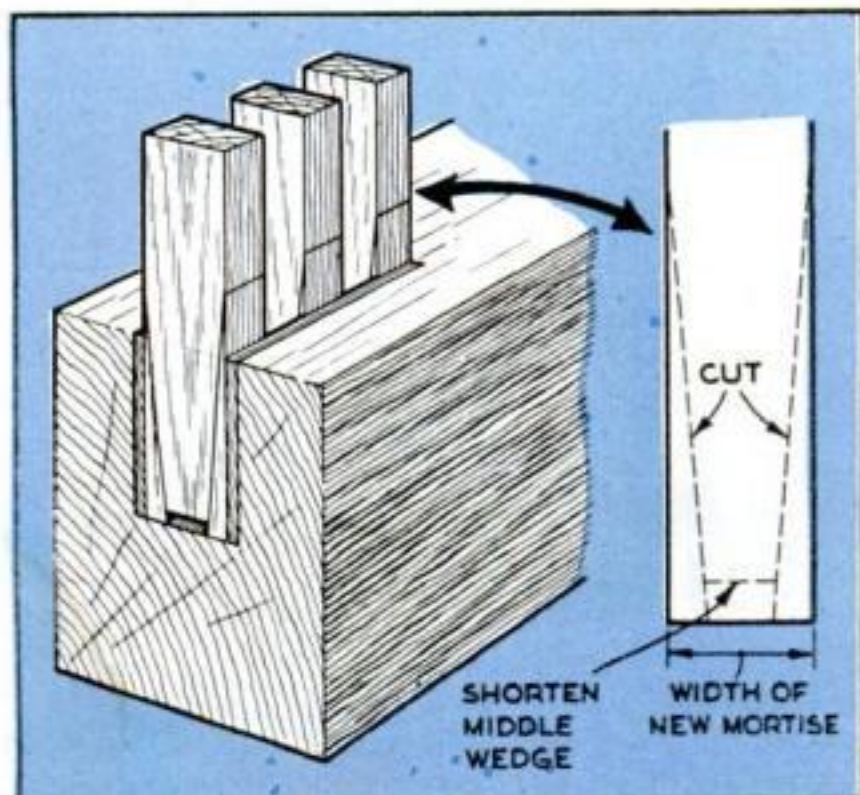
Mortise Is Built Up with Shims to Strengthen Joint

WHILE reconditioning an old four-poster bed, I found that the mortises in the posts had worn so much that it was impossible to

get a tight joint. The problem was solved by building up the mortises with shims as shown at the left.

After each old mortise had been cleaned out and enlarged slightly, shims were cut to build up the mortise to suit the existing tenon. The shims then were wedged in place while the glue was drying, the wedges being made by cutting short pieces of stock to the thickness of the finished mortise, taking slanting cuts on each side of one end as illustrated, and marking the mating pieces. The center piece was also shortened slightly so it would clear the bottom of the mortise when driven in.

If the shims have been cut the proper thickness, the mortise will be ready for the tenon as soon as the glue has set and the wedges are removed. The number of wedges required will depend on the length of the mortise.—H. M. Childs, Mobile, Ala.



Chest Faced in Matched Veneer

By Joseph Aronson

An architect whose specialty is interiors (see page 98), Joseph Aronson is also well known for his work in furniture design. He is the author of The Encyclopedia of Furniture and Furniture and Decoration. Here his adaptation of a striking old chest is a challenge to fine woodworking craftsmen.

EXECUTED in the elaborate walnut veneers characteristic of the early 18th Century, this small chest is a close copy of a particularly fine antique originating in England somewhere around 1720.

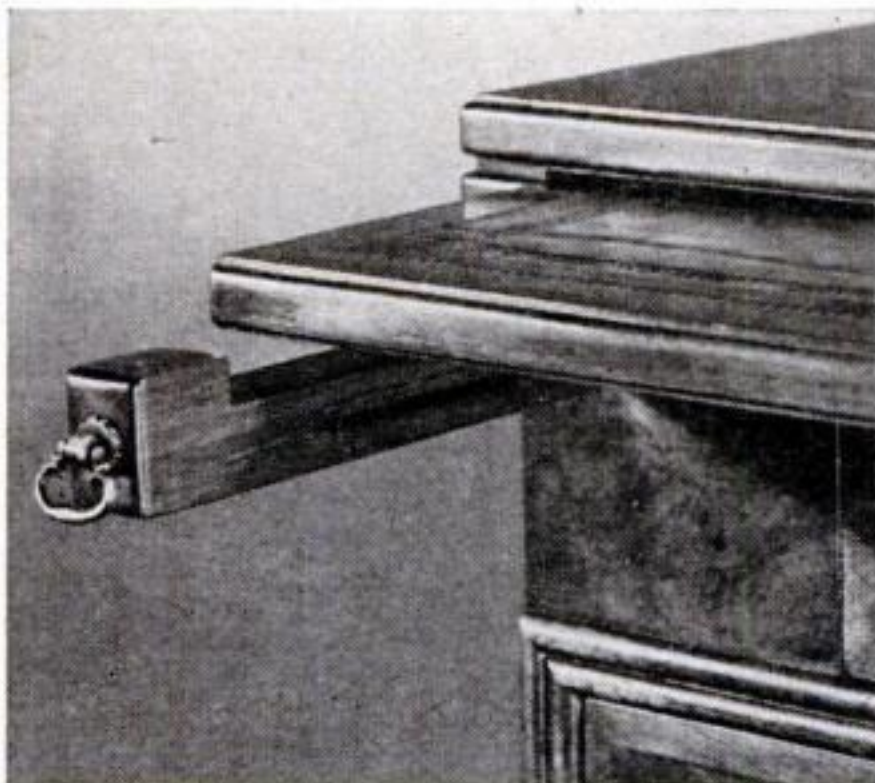
The date of the original can be set fairly precisely because modification of English importing laws in 1733 encouraged extensive use of mahogany. Previously, the finest work had appeared in complex surface designs of walnut veneers, sometimes so ornate that the fundamental shape of the piece was subordinated to decorative facing.



Standing 29½" high, it's known as a bachelor's chest.

A fine copy of the careful handicraft of that period, the illustrated chest demands a degree of craftsmanship equal to that of the cabinetmaker who produced the original. However, to the man possessed of the skill and patience to carry the project through, the result will certainly be a piece of rare beauty and satisfaction.

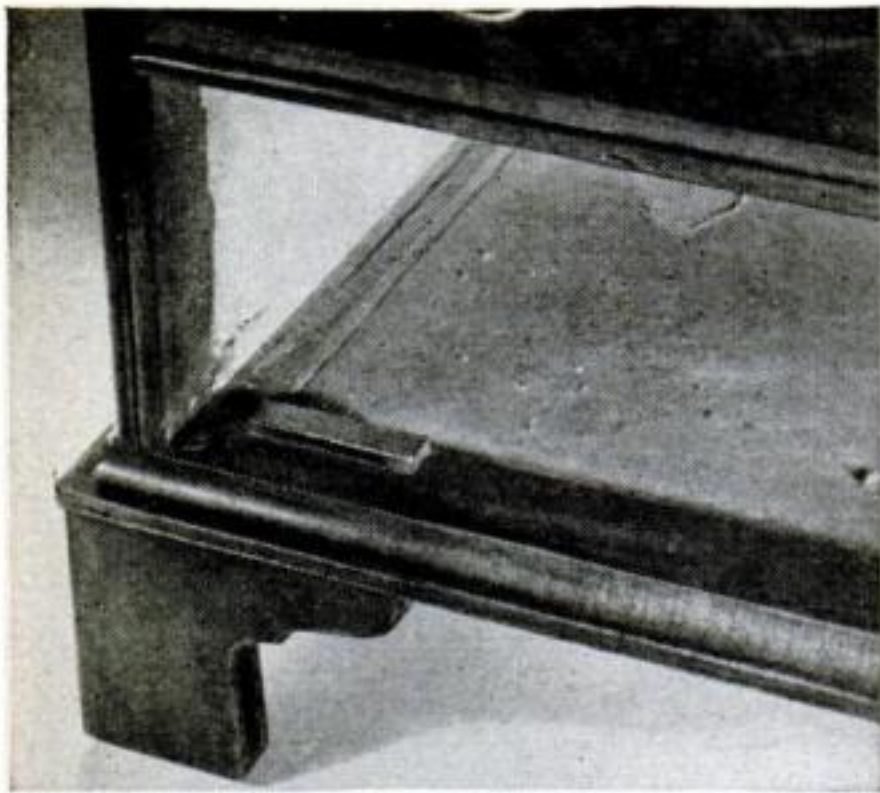
Although the accompanying drawing spe-



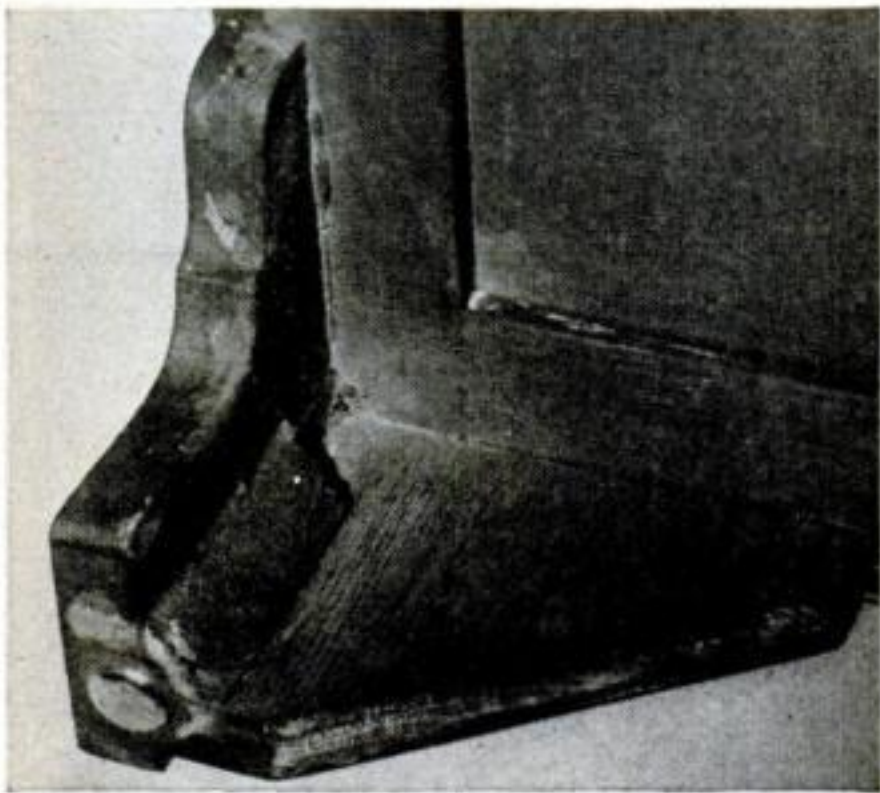
A walnut runner in hammer form supports the pull leaf. The leaf top is faced with leather.



Double half-round molding sets off the lower drawers. Also note the molding around the top.



A cross-veneered cavetto around the base is a fine touch, although solid wood can be used.



Identical brackets at each corner support the chest. The framing for the case is conventional.

cifies walnut, the design might also be executed in solid mahogany or other wood that will take a fine finish. The pattern in the veneers is formed in the customary way by pasting up cut pieces with tape on a brown-paper ground and applying it as a whole to the surfaces of the chest.

For the two sides and the top, four sheets of burl walnut veneer are quarter matched to form a sort of center star or flower. Each drawer facing consists of two leaves of the same veneer, matched at the center. Solid walnut may be used for the framing faces.

The top has a 7/16" border of a light contrasting veneer, such as English ash or a wood of similar comb-grained character. In the original, as in the replica, the comb grain runs at 45 deg. to the rectangle, with the match occurring at the centers. The same

7/16" border applies to the drawer fronts, but not to the sides.

It is well to stress the fact that the backing should be veneer of approximately the same character as the facing. For example, if you apply a walnut face veneer, say to a birch or gum plywood panel, then the backing veneer should likewise be walnut.

Veneers Must Dry Thoroughly

Allow the veneers several weeks to dry before cutting the case work. With burl veneers you must always expect a certain amount of checking—fine hair cracks that show through the finish several months after completion. Even many pieces in museums have these characteristic crackings, and ordinary gluing methods will not prevent the action.

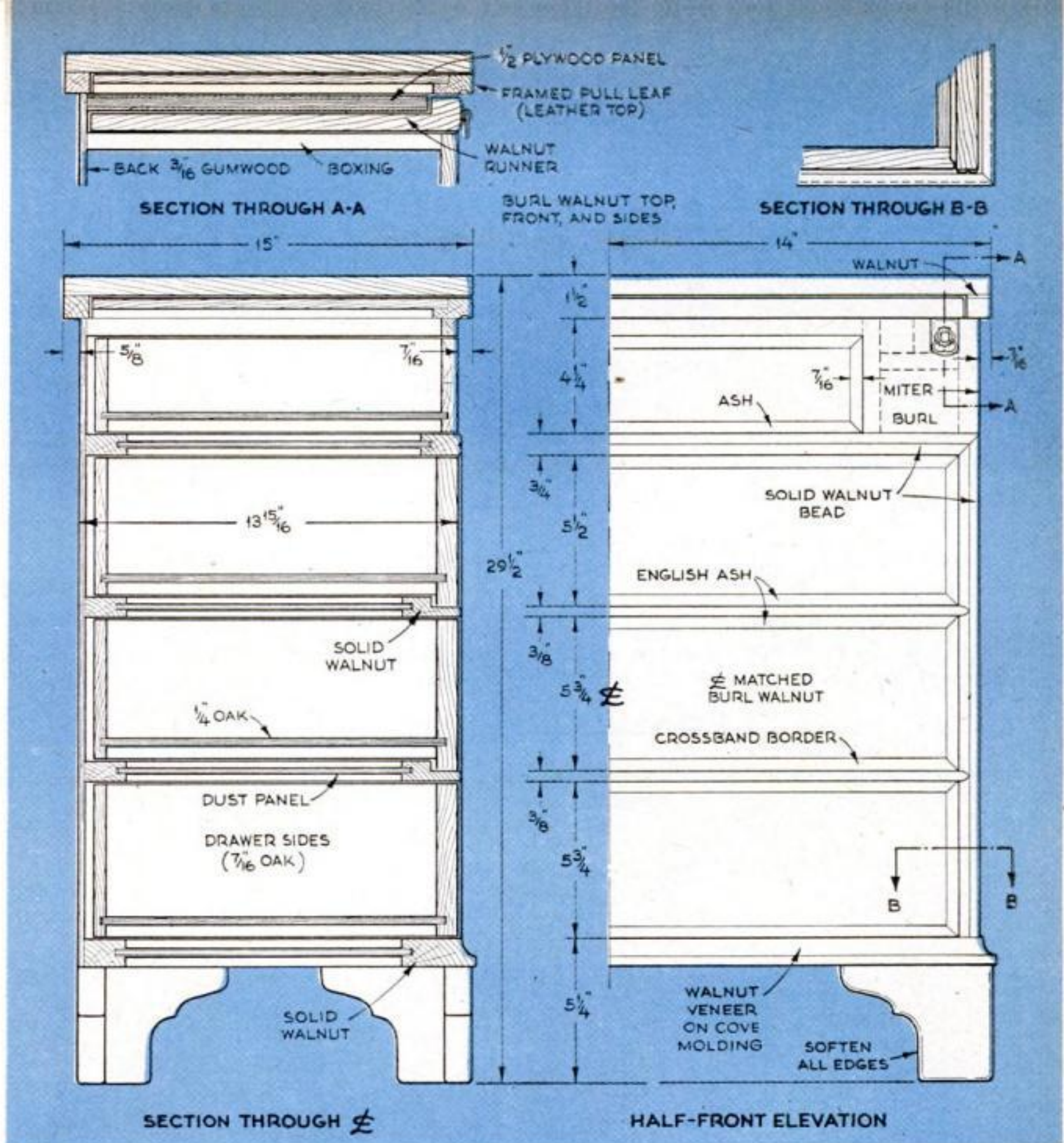
All the drawers are of conventional construction, and the case employs dust-panel framework doweled into the sides. Front frame members are solid walnut, the forward edges of the center three being rounded off. The bottom framing member appears as a cavetto along the front and both sides. This is a concave quarter-round molding that the worker in solid wood can run with a shaper or molding plane.

However, if you wish to conform to tradition, you face the problem of applying veneer the short way in the curve. This involves making a reverse mold of identical profile that can be pressed with clamps into the edge mold while the veneers set. Although this is a particularly fine touch, it can of course be omitted. Even if you use veneer facing on the rest of the chest, it wouldn't be out of keeping to make the cavetto in long grain solid walnut.

Pull Leaf Framed in Solid Walnut

Since the top drawer is shorter than the lower three, space is provided for the walnut leaf runner and the floor on which the leaf slides. The leaf is framed in 7/8" solid walnut mitered at the two front corners, and a 3/4" panel is rabbetted deep enough to bring the leather top flush with the upper surface of the framing. In this example, the leather is a natural finish top-grain steer hide, tooled in gold and lacquered to a polish.

Molding of identical cross section is cut on the edges of the top, the pull leaf, and the framing members for the latter. When gluing the framing members under the top panel, insert a single thickness of walnut veneer to make space for the leaf to run



free. As a matter of design, the leaf support is allowed to project from the case about $\frac{1}{4}$ ". Round off its front edges, and apply felt or leather to the top surface of the hammer head.

Each corner of the bracket base consists of two identical pieces mitered together, corner blocked, and doweled and glued to the lowest frame of the case. From the point of view of design, it is preferable to have the grain of these pieces run vertically.

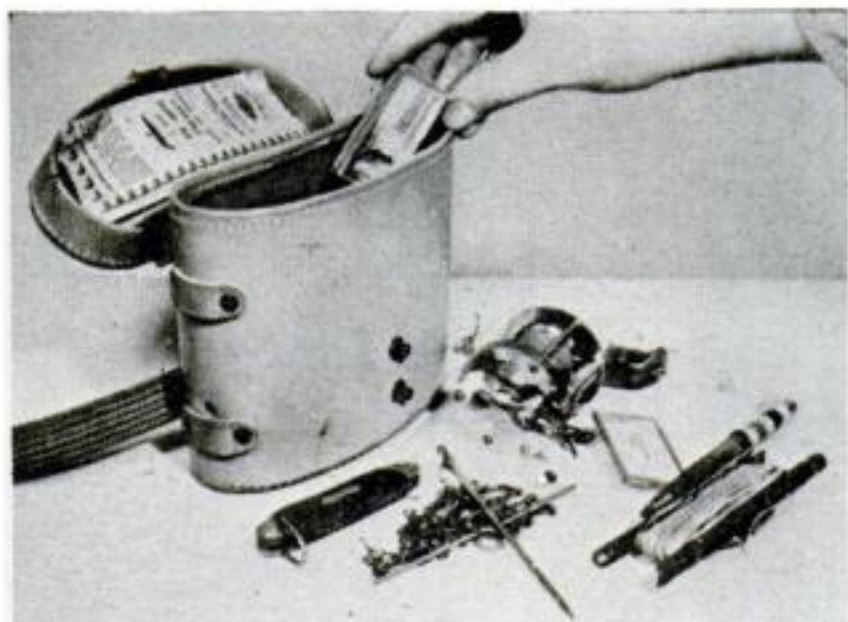
Finishing the veneer surfaces calls for a lot of patience. The characteristic color of such old walnut pieces is a tawny brown with a high satiny texture. Begin by applying an aniline yellow stain irregularly. Then bleach the entire surface lightly and follow with a sealer. Although a fine wash of rabbit-skin glue tends to hold the veneer to-

gether better than any other material, a very thin coat of white shellac will do a fair job. Sand down this coat without mercy and follow with others until the desired fullness is achieved.

Then glaze with a smudge coat of raw umber and burnt sienna, mottling in an occasional dab of Van Dyke brown. The palm of the hand is the only satisfactory tool for this work, and the eye the only judge of how far to go. When you have the glaze you want, apply several coats of dull lacquer or white shellac, sanding down each with 5/0 paper after allowing plenty of time to dry. The final satiny glow comes from a well rubbed coat of hard wax.

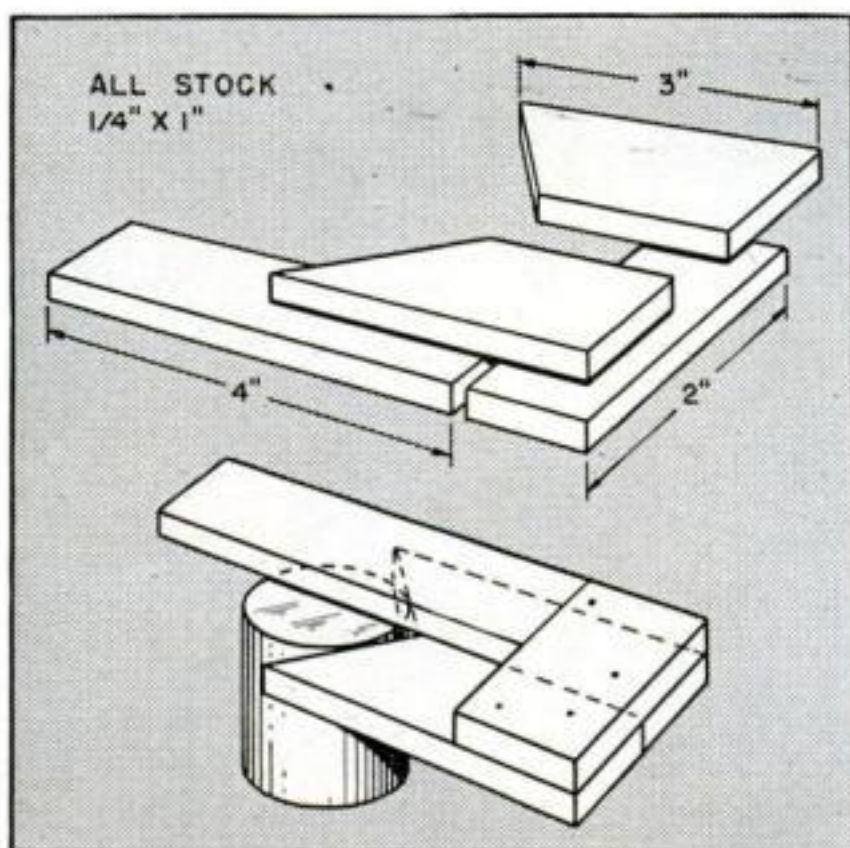
To see the job through, you should choose hardware of a quality and style consistent with the chest design.

END



Binocular Case Is Tackle Box

IF YOU'RE tired of lugging a heavy fishing-tackle box, here's a happy solution. Get one of the surplus binocular cases that are now available at low cost in many localities. The case will usually hold just about everything needed.—H. Leeper, Canton, O.

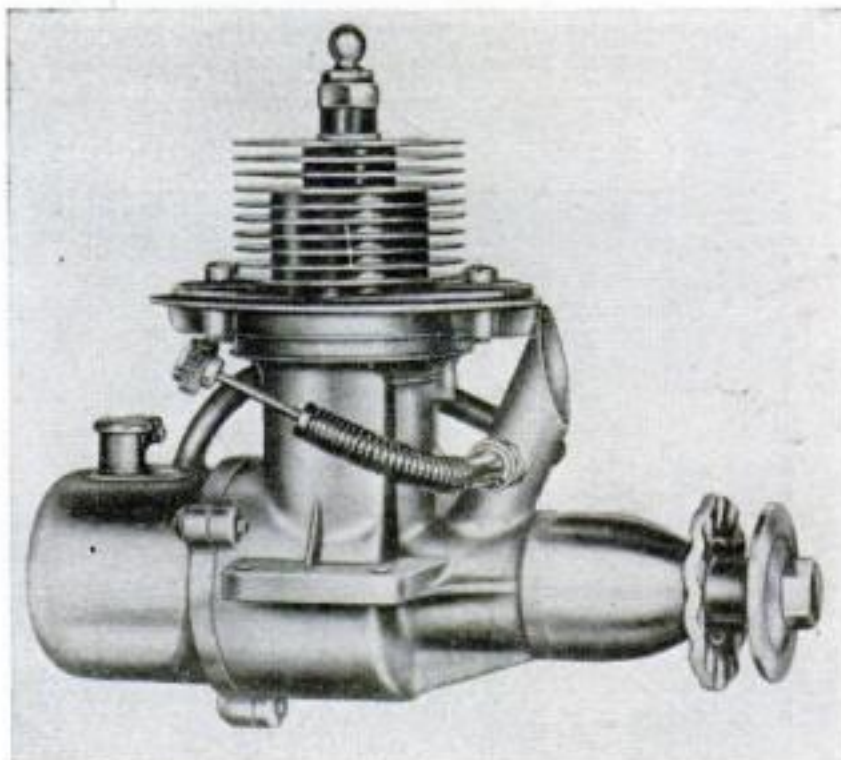


Center Finder Works Quickly

WHILE making some small turnings, I hit upon this idea for locating the center of round stock. It works like a charm.

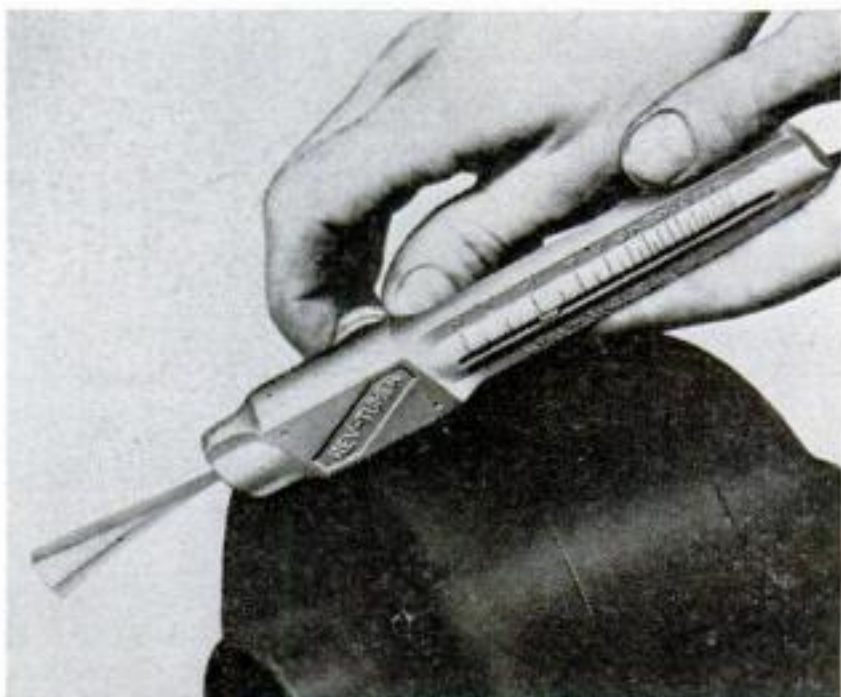
Using $\frac{1}{4}$ " hardwood, rip a strip 1" wide and about 15" long. Then cut off one 4" piece, two 3" pieces, and one 2" piece. Miter each 3" piece to 45 deg. at one end, and assemble all the pieces as above, tacking them together with or without glue.

With the device held on the end of the round stock as above, scribe a line close along the 4" strip. Revolve about 90 deg. and scribe a second line. The lines will always intersect at the exact center of the work.—J. W. Jay, Palmyra, N. J.



Engine Designed for Glow Plug

ENGINEERED for glow-plug operation, this new class B model-plane engine features a heavy crankshaft and bronze main bearing that are said to counteract the stresses of pre-ignition firing. Started by connecting a $1\frac{1}{2}$ -volt battery to the plug, the engine then runs by pre-ignition, using a special fuel. It's made by the Herkimer Tool and Model Works, Herkimer, N. Y.



Tuner Measures Engine Speed

THIS new pocket-size instrument for determining the speed of an engine or motor makes use of the tuning-fork principle. The instrument is held against the motor while a vibrating steel "reed" is adjusted in length by means of a thumb control on the handle until it's in tune with the vibration frequency of the motor. The speed (r.p.m.) of the motor is then shown directly on a scale. Called the Rev-Tuner, the instrument is manufactured by Rev Products Company, Elmira, N. Y., and retails for about \$7.50.



Handmade Links Form Necklace

CHAIN necklaces like this are a cinch to make and a beauty to behold. The design is probably 6,000 years old, for Egyptian craftsmen turned out some of the same type.

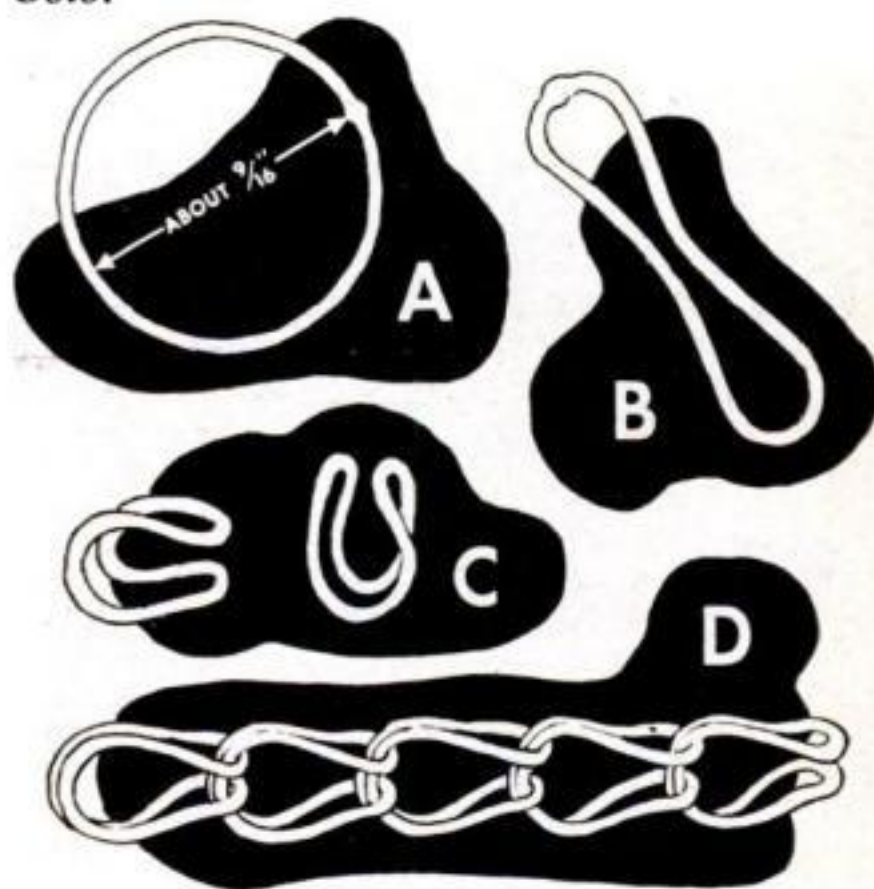
For this particular chain, I used a little over an ounce of annealed 20-gauge sterling-silver wire. The wire was wound on a $\frac{1}{2}$ " mandrel, yielding circles of $\frac{9}{16}$ " inner diameter because of the outward spring when removed. These circles were cut apart with shears and filed smooth (a jeweler's saw might have been better). Silver-soldered to form closed rings, they were cleaned by pickling for five minutes in a 20-percent solution of cold sulphuric acid.

Each one was next smoothed out into a perfect circle (A) by lightly hammering with a rawhide mallet onto a tapering mandrel. They were then shaped (B) by finger pressure over a $\frac{5}{32}$ " drill shank, doubled into links (C), and assembled (D).

To make the chain continuous, one end link was cut, inserted in the other end link,

and soldered. The two loops were cut and soldered separately.

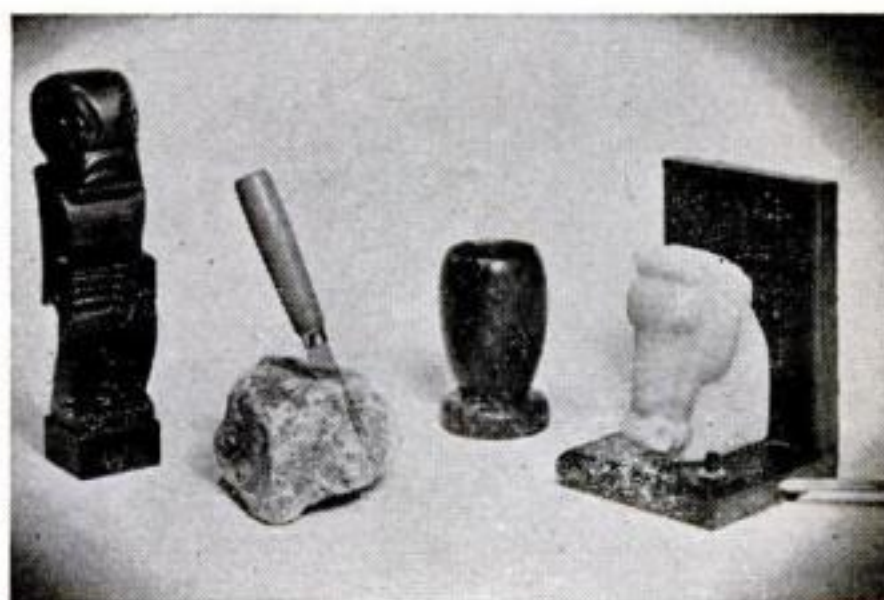
The finished chain contains 115 links. It's 36" long, and weighs approximately one ounce.—L. McFarling, Colorado Springs, Colo.



Soft Stone Is Readily Carved with Hand Tools

HERE are a few examples of what you can do with Sculpsstone $\text{\textcircled{T}}$, a commercial form of steatite, a mineral craftsmen have carved since the days of the Pharaohs.

Although the material is easily worked even with a knife, as shown, finished projects may be hardened. The horse's head at the right suggests the novel effects that are possible; an electric bulb inside lights up the translucent green stone. The material is available in several colors from Sculpsstone, Inc., of New York.





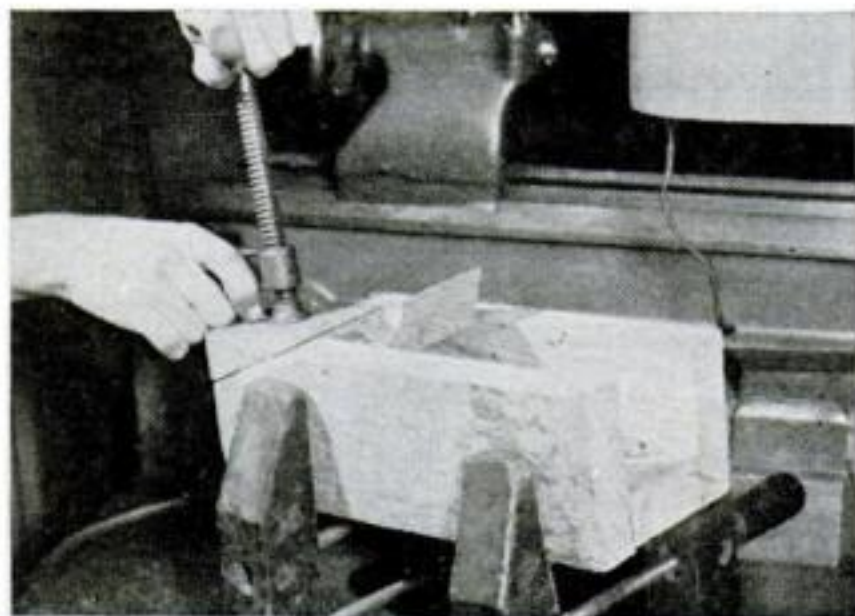
Though he stares at you quizzically, this little man is very obliging about taking messages.

Silent Sam Takes Your Messages

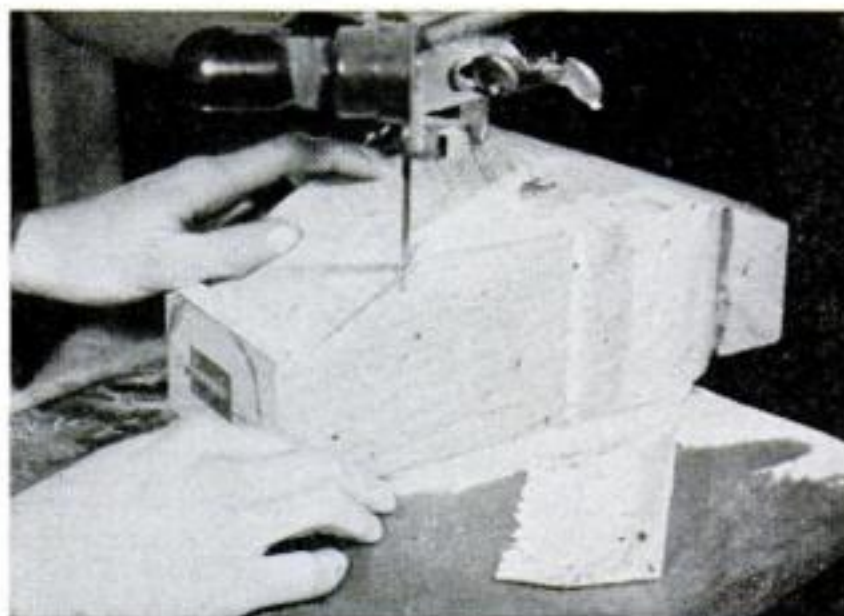
PEOPLE will call on you just for the fun of finding that you're not at home if you have this carved note box at the door to

take messages. A tug at the old fellow's watch fob provides them with pencil, paper, and a writing surface.

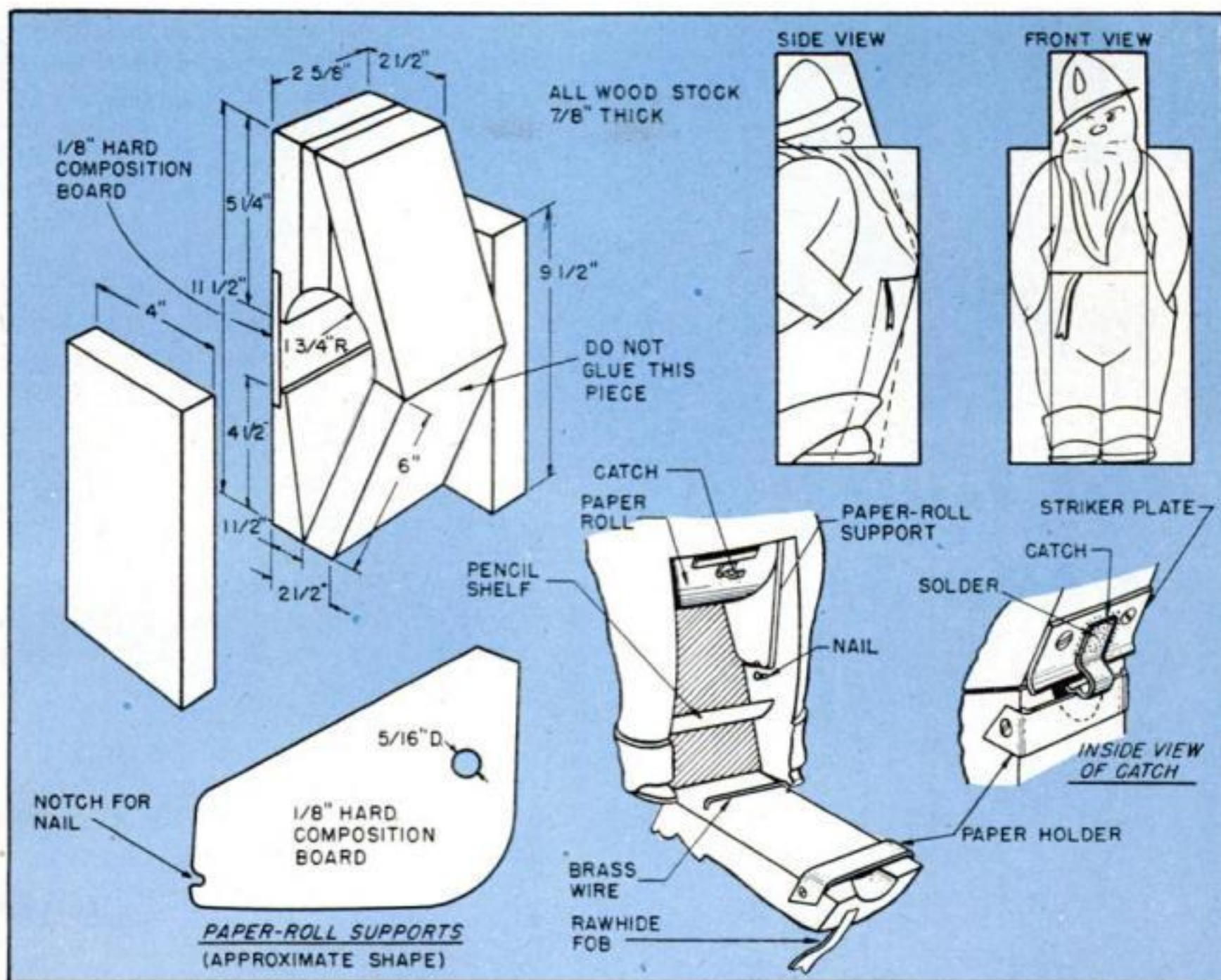
Glue the two cheeks to the three back sections, which are just 2½" wide to take adding-machine tape and two roll supports. Don't glue in either front block just yet; the lower one is hinged at the bottom to swing out and down, while the upper one shouldn't be attached until you have formed the meeting bevels and built the catch assembly. The back of the lower should be smooth.



Glue up pieces of wood to make the carving blank. Be sure to use a good waterproof glue.



Draw front and side views on the block and saw around the outline before beginning to carve.

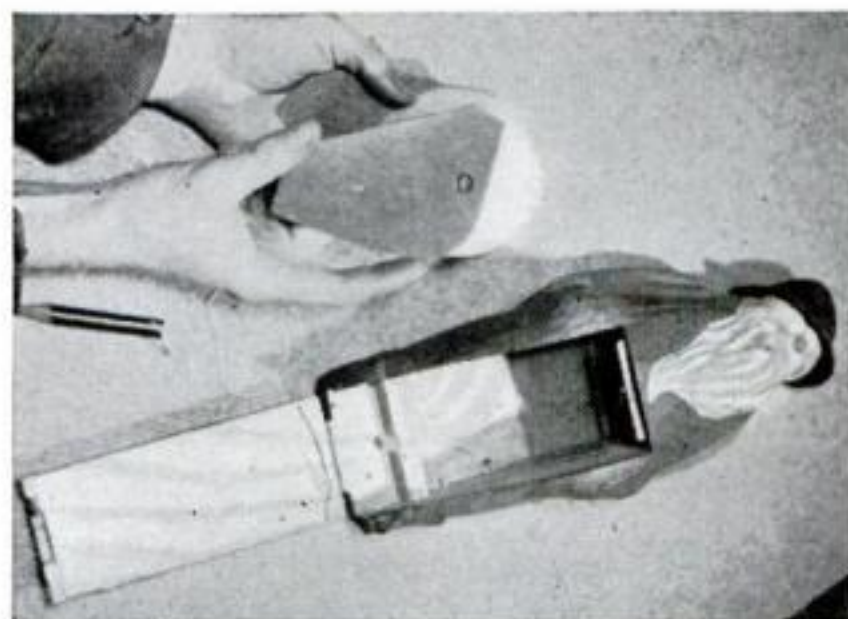


Draw the outlines onto the block and saw and carve it to shape. A small gouge will give texture to the beard; most of the other surfaces can be finished with a flat chisel. Work over the entire figure instead of finishing one part at a time. Cover the overalls with walnut oil stain, use India ink for the shoes and hat, and indigo drawing ink for the shirt. Two coats of linseed oil will complete the finish.

The pencil shelf consists of a slightly hollowed strip of wood bradded from the outside of each leg. Be sure to leave clearance for the paper to slide behind it. A length of string tied to the pencil will serve as a reminder for absent-minded callers. Mount the finished box in as sheltered a spot as possible with two 1 1/2" wood screws driven through the back of the figure behind the roll.—W. A. Conway, Macedonia, O.



Rough the figure with a gouge; then work in the full details with a flat chisel or carving tools.



Paper-roll supports, notched and drilled for a dowel, hold the roll of adding-machine tape.



Old Bottles Cut to Make New Mugs

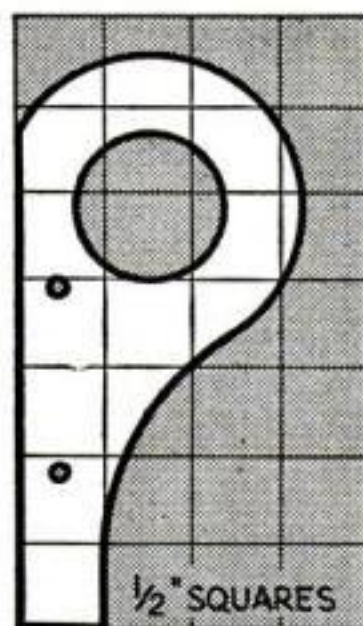
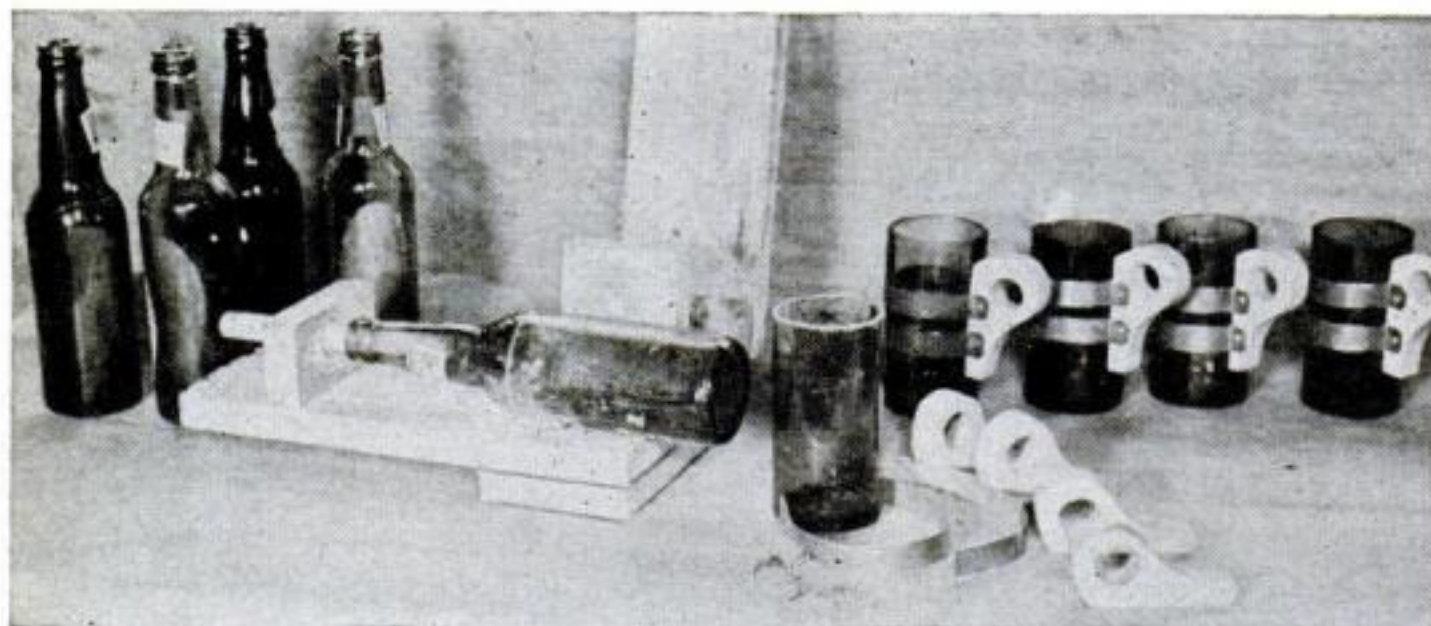
ONCE you know how, cutting bottles into mugs isn't a tough job. You'll find that a matched set of green or amber mugs will make an unusual and attractive gift. If possible, use bottles that have been made fairly recently, since they seem less apt to chip in the cutting.

Although you can do the cutting with

an electrically heated wire (PS, Feb. '45, p. 202), I get good results with an abrasive cutoff wheel. A jig consisting of a trough hinged to swing into the wheel holds the bottle, while a dowel extending from one end of the jig enters the neck of the bottle and steadies it. I mount the wheel in a wood lathe, clamp the jig beneath, and set the belt for a fairly slow speed—about 800 r.p.m. with an 8" wheel. A water can is arranged for a steady drip at the point of contact.

The bottle must be turned constantly while it is in contact with the cutoff wheel, so I press the jig lightly toward the wheel with my body while rotating the bottle with left and right hands. Uneven breakage is likely if you try to cut all the way through; I stop after the wheel has cut through about half way, and then break the upper part off by applying pressure. The cut edge is dressed with an emery wheel under a water drip, and a small bevel ground on the edge with a finer stone.

Handles are jigsawed from $\frac{3}{4}$ " stock after the finger holes have been bored. The inner edge is shaped to conform to the surface of the bottle by pressing it against a 2" sanding drum. Sheet copper bands $\frac{5}{8}$ " wide are cut about 1" longer than the mug circumference, the ends drilled, and the bands bent around the mug and secured with $\frac{3}{8}$ " wood screws. —L. A. Marks, Redwood City, Calif.

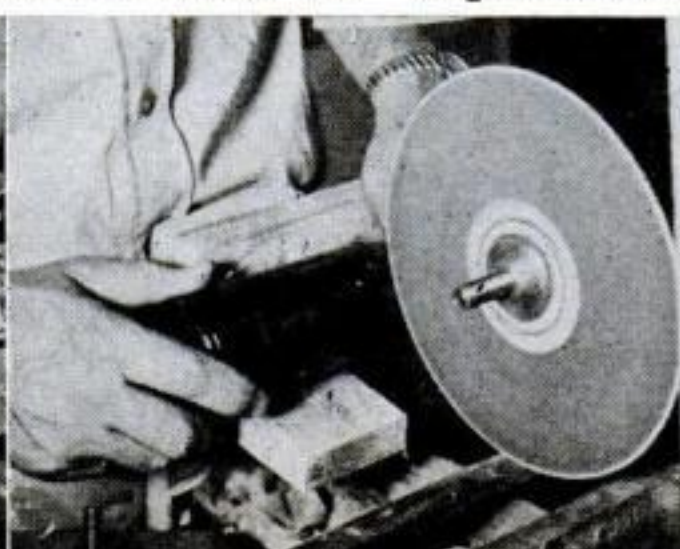
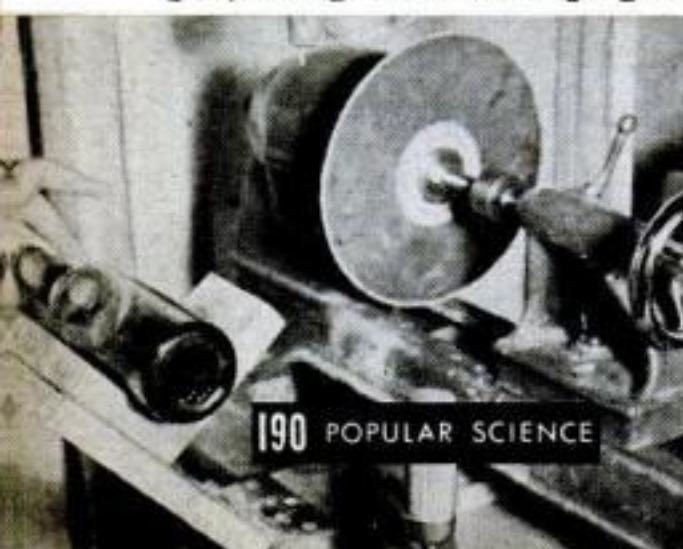


Beer bottles were the raw product from which these mugs were fashioned. Two copper bands

For the circular cut, the bottle is held against the abrasive wheel in a hinged cradle. A dowel projecting from an upright at one end of the

$\frac{3}{8}$ " wide bind the handle to the mug. Cut the handle out of $\frac{3}{4}$ " stock to the pattern above.

jig fits into the neck and allows the bottle to be rotated as the cut is being made. Grind the edge smooth on an emery wheel, as below.



Ivy Pot from a Coffee Can

GLANCING at this wishing-well ivy holder, you might not suspect its base is nothing more than a coffee can. But that's what it is—closely wrapped with brown twine. The uprights are 10" lengths of $\frac{3}{4}$ " by $\frac{3}{4}$ " wood nailed to the can, each cut to a point on top to suit the roof slope.

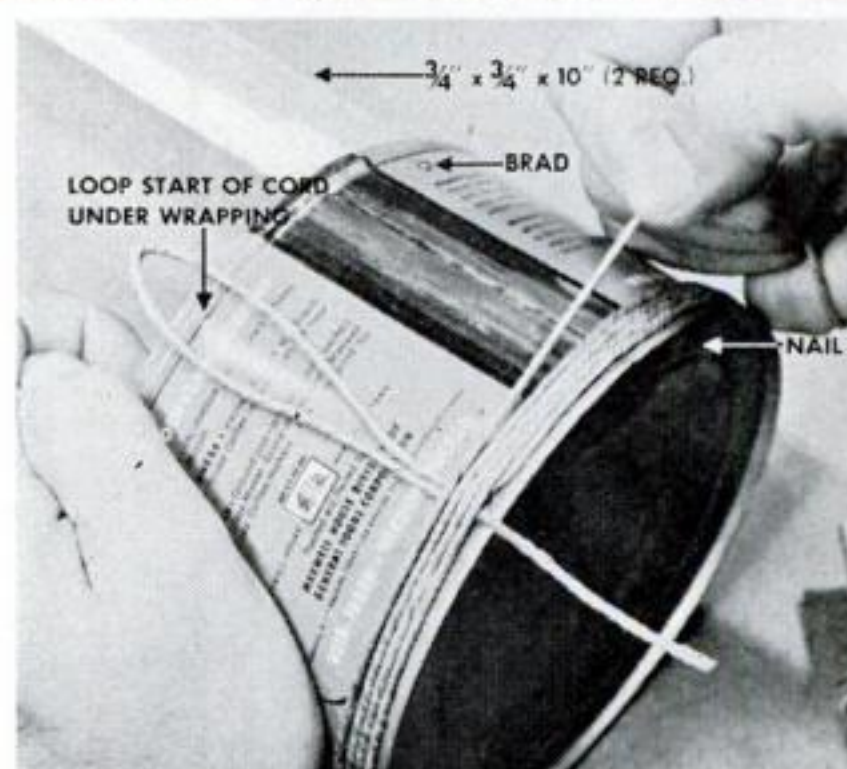
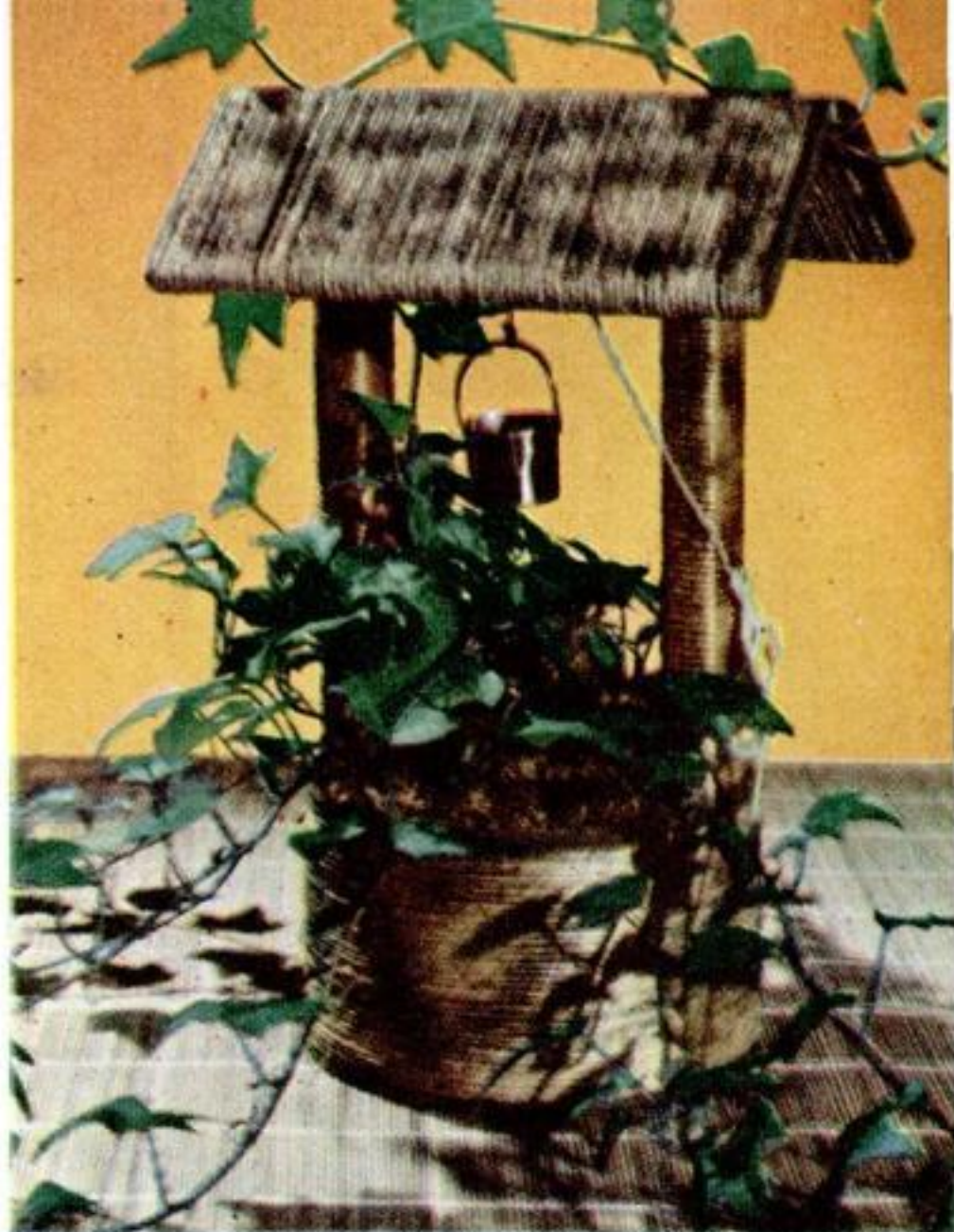
To wrap the can, make a loop in the start of the cord and, with the loop flat against the side as seen in one of the photos, bind it in place with successive turns of the twine. As you go along, keep the strands straight. When you reach the upper edge, cut the twine, stick the end through the loop, draw both under several turns by pulling the loose end of the loop, and cut off the waste ends.

Wrap the uprights from the bottom up, fastening the twine ends with long wire brads. Cut two 2 $\frac{3}{4}$ " by 7 $\frac{1}{4}$ " roof pieces from cigar-box wood, wrap them in the same way, and nail to the uprights, setting the nailheads flush and then pushing the strands of cord back into place. Put a dab of cellulose cement at each point where the wrapping begins or ends.

Make the bucket from light copper or tinplate, soldering on a wire handle. Suspend by a cord passed through a staple under the roof and tied to a small nail driven into a post.

A decorative surface treatment may be given the wrapped areas by lightly charring with a small torch. Paint the raw wood edges dark brown, and give the bucket and all the wrapped surfaces a light coat of shellac.—*Bill Luther, Los Angeles.*

Cut the cord when wrapping is complete, place the end through the loop, and pull both under.



Loop the start of the cord and bind it against the side of the 1-lb. coffee can as seen here.

Decorate the wrapping by directing the flame of a small torch on it in a random pattern.



How to Square Stock with Power Tools

They make woodworking more fun by turning out better work in less time.

By Edwin M. Love

SKILL and equipment in woodworking usually grow up together: the longer you've been at the game, the more adept you become at it and—invariably—the more tools you acquire. Perhaps that's as it should be, but the lucky beginner who can start out with one or more power tools will not only find his work made easier but will also be rescued from the apprenticeship needed to gain real mastery over hand tools. You don't *have* to have labor-saving machines, but if you're planning to get them "sooner or later," the quicker you get around to it, the quicker you'll discover how much fun and solid accomplishment you've been missing.

The versatility of most home-workshop machines has been pointed out previously in this series. Just as you can use any of a number of tools for surfacing stock, so can you make almost any machine serve for squaring ends and edges.

A jointer is probably the best bet for establishing a true working edge. If the edge is reasonably square to begin with, set the jointer table as for surfacing, adjust the fence to square position, and with the trued face against the fence (this side will be





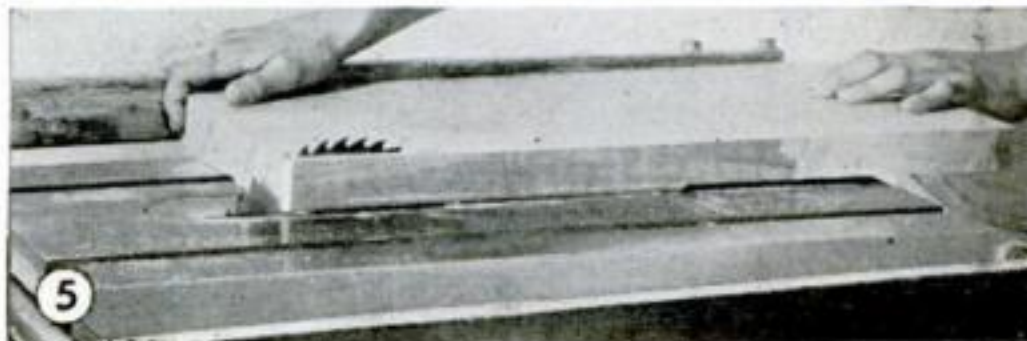
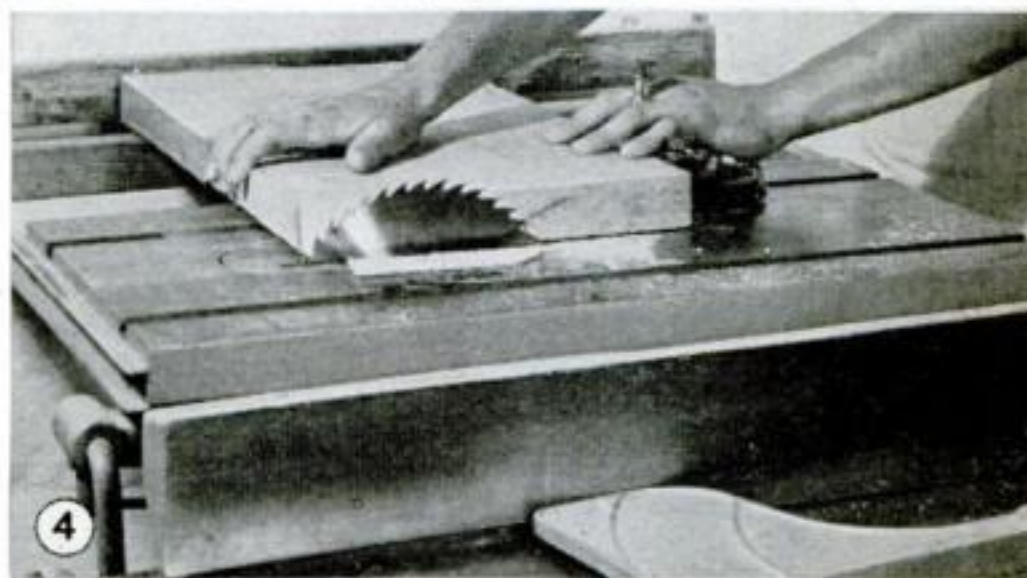
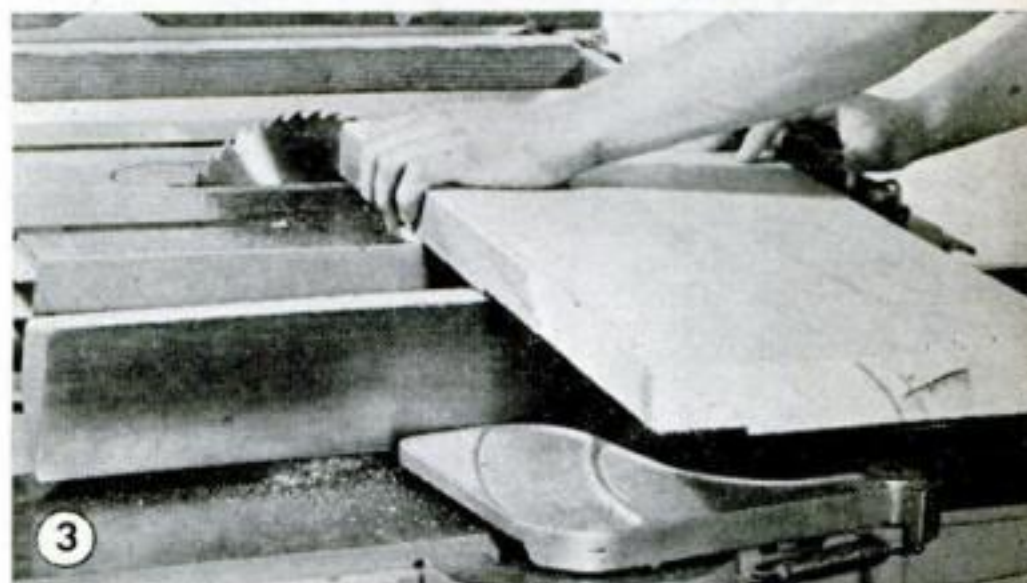
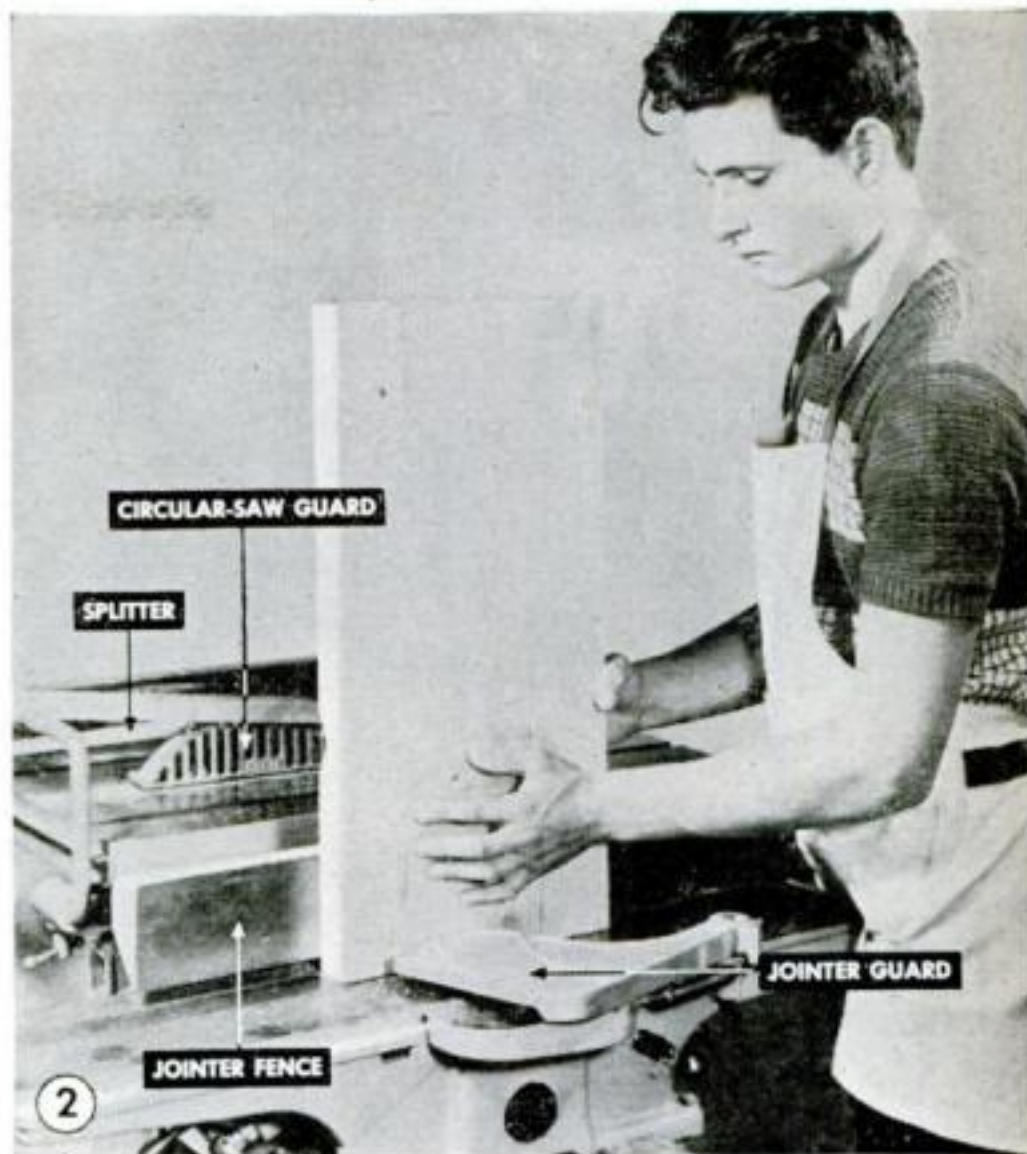
against the fence or table in all cutting operations), pass the board over the cutter as illustrated in Fig. 1. For a very uneven edge, it is best to tack or clamp a straight-edged strip to the face. Locate it exactly parallel to the edge you want and just high enough so that it will ride along the top of the fence. When squaring an end (Fig. 2), remember to chamfer a corner to prevent splitting of the trailing edge.

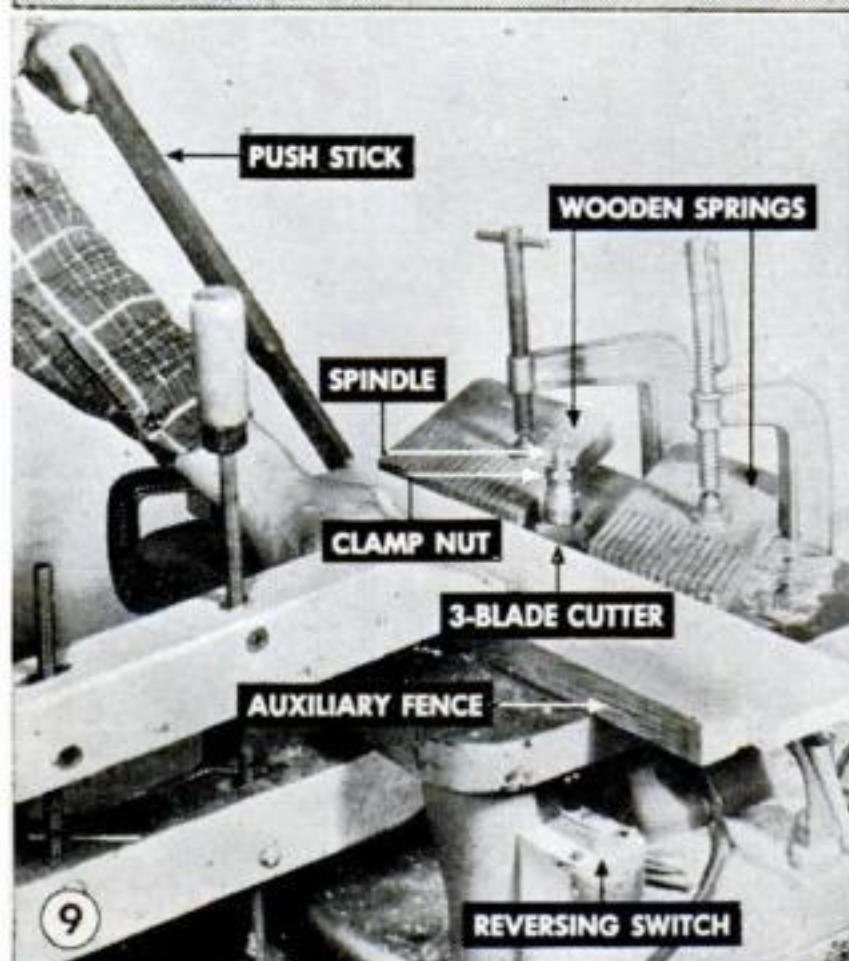
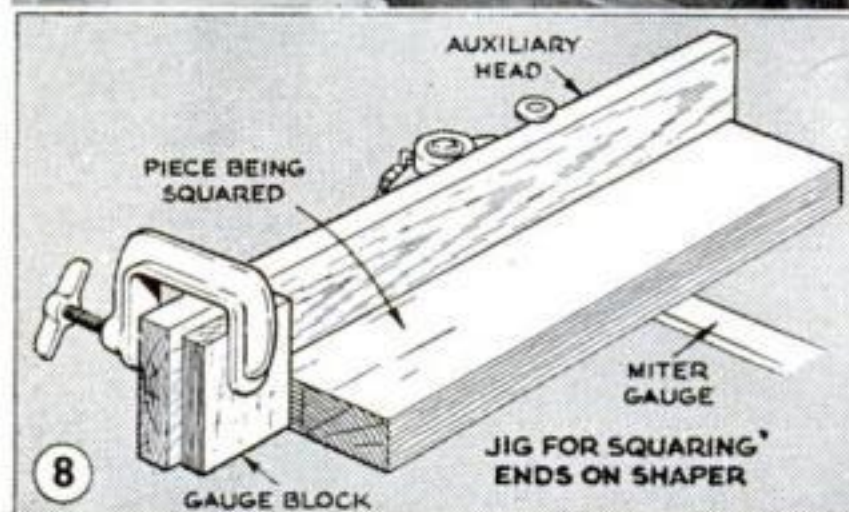
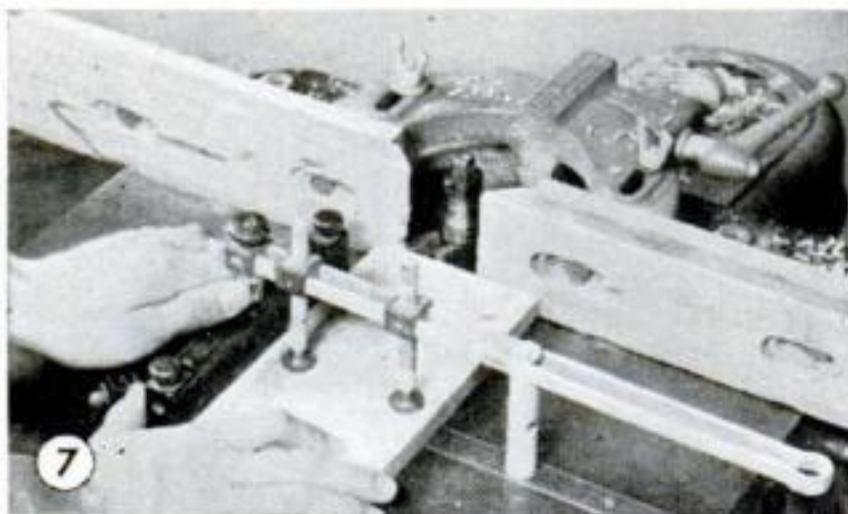
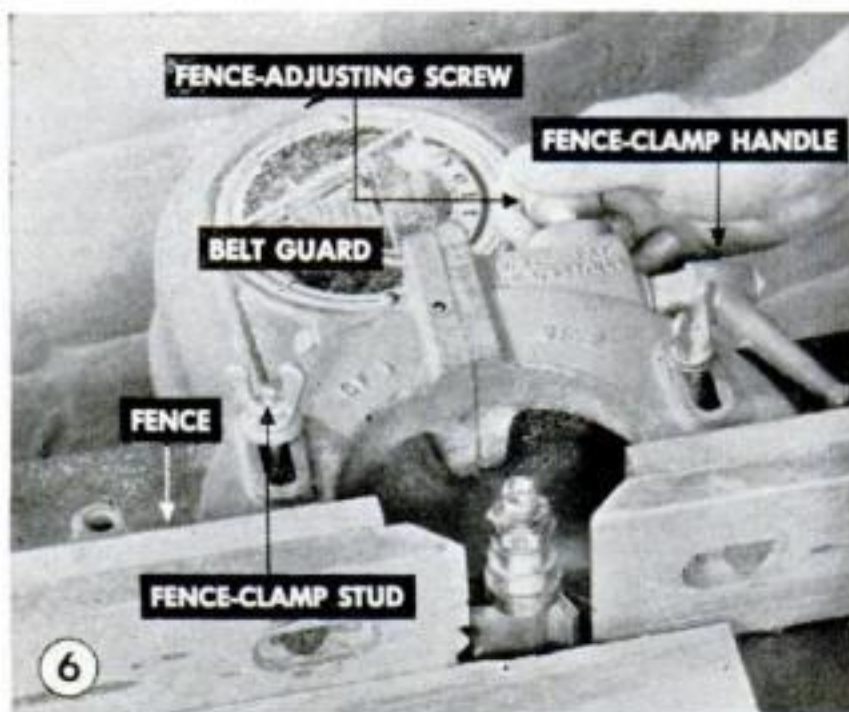
A circular saw will also do a fine squaring job. To obtain your first working edge it may again be necessary to tack a strip parallel with the edge you wish to produce, and located so that as it rides the table edge, the blade will trim off all irregularities. Adjust the saw depth so that the teeth just project above the top of the board. For difficult cuts you may have to raise the blade somewhat, but the lower setting is safer and should be used whenever possible.

Once you have squared the first edge it is a simple matter to make the remaining cuts. Set a squared miter gauge in one table groove, place the trued edge of the piece against the gauge, and push the board forward to trim the end (Fig. 3). Mark the length, shift the miter gauge to the other table groove, and saw the board to size as in Fig. 4. Even when there is only one groove on the table, you can still keep the face side down and the working edge against the gauge by turning board and gauge end-for-end.

Adjust the fence for ripping to width by measuring from it to the point of a tooth set toward it. Alternatively you can mark the board and use it as a measure. Since the fence-clamping mechanism may shift the fence position a trifle, it is important to check the measurement after locking the fence. The position of a board between fence and blade is illustrated in Fig. 5.

Frequent shifts from ripping to cross-cutting are necessary in the home shop, so a combination blade is usually mounted on





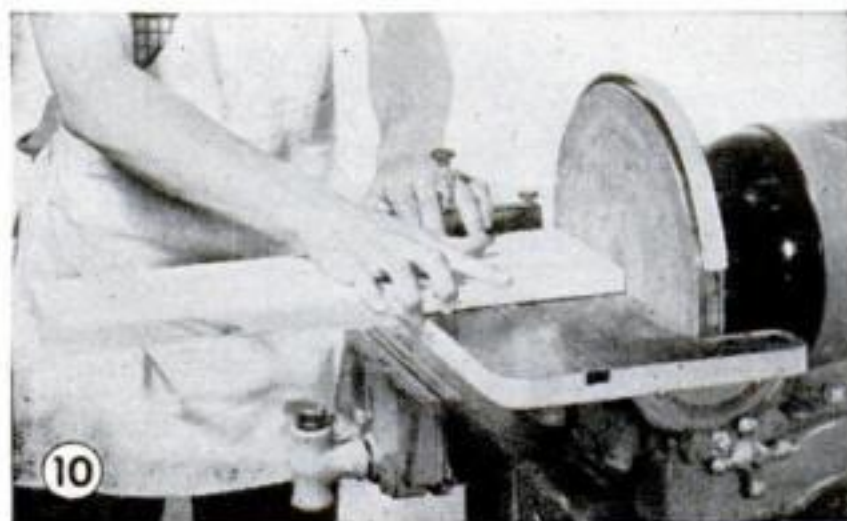
the saw arbor. The blade projects above the table through an opening in a soft-metal insert. When changing blades, tighten the new blade on the arbor with the brand name up. The teeth should of course point in the direction of rotation.

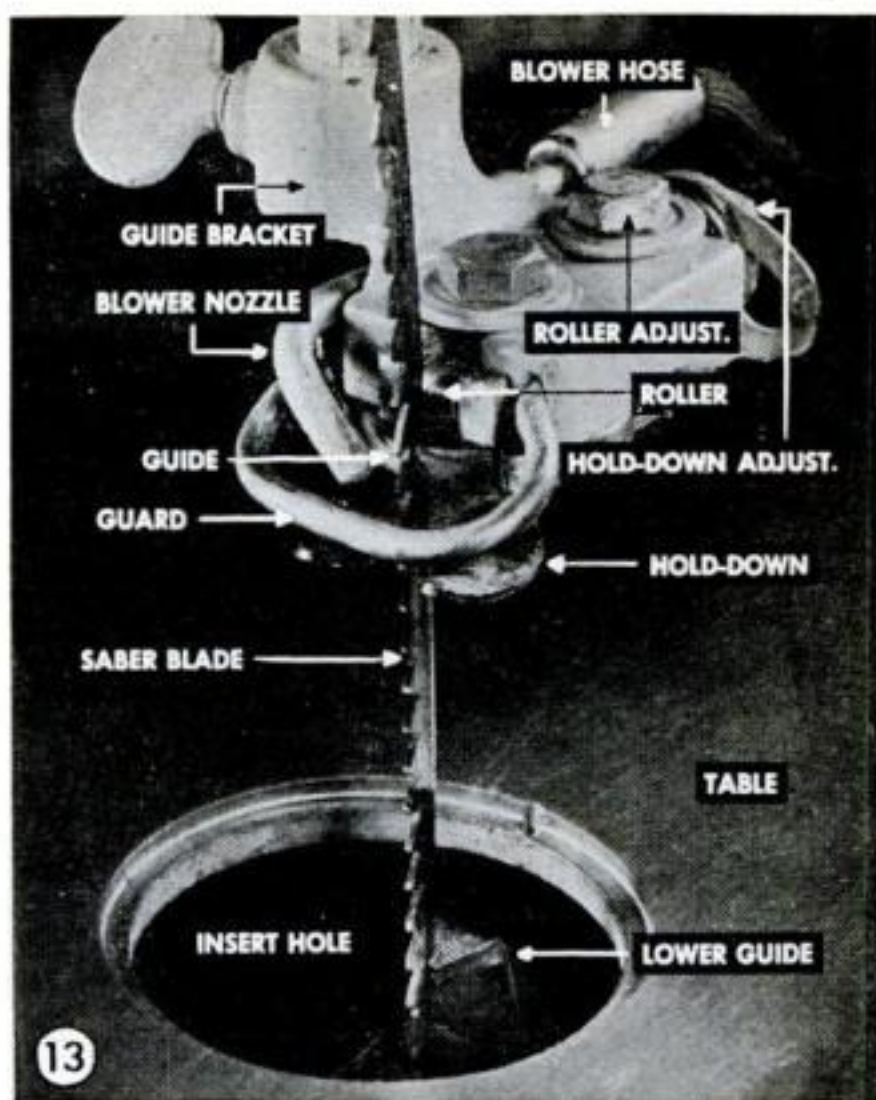
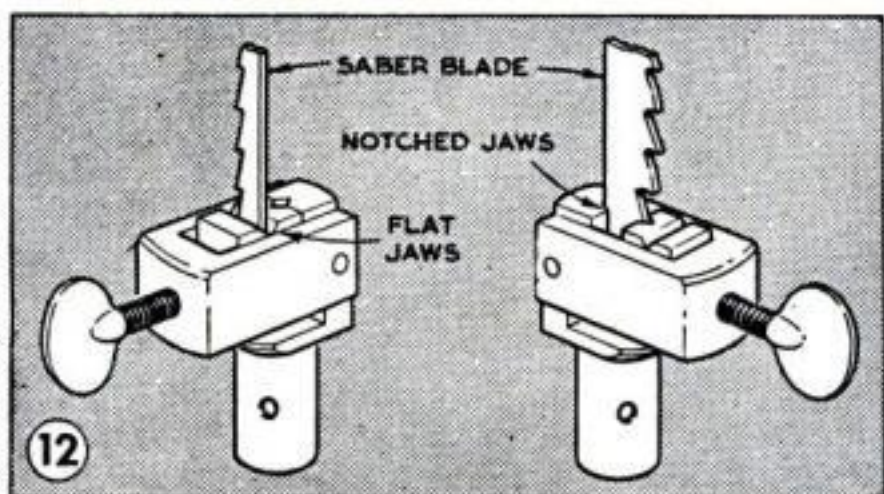
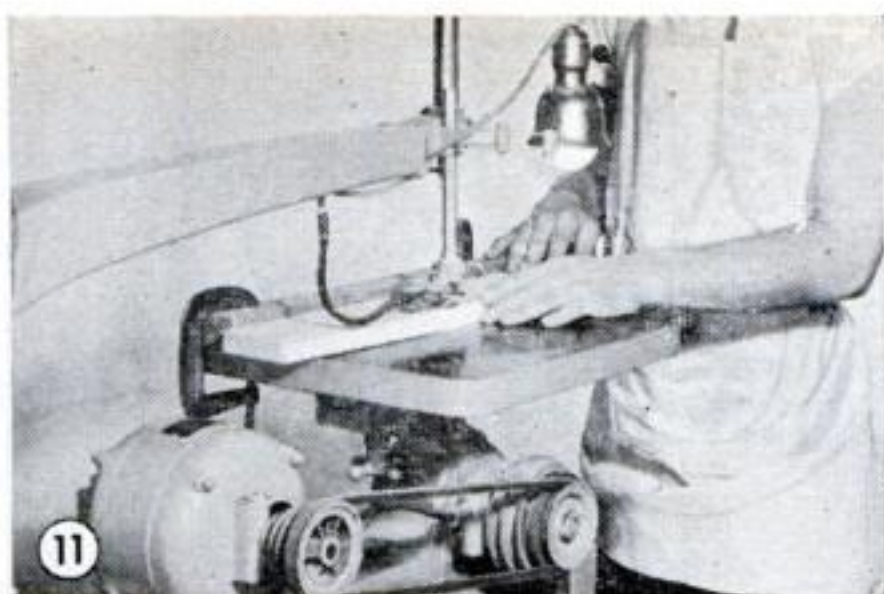
If you turned a jointer over on its back, you'd have a tool that looks pretty much like the standard shaper (Fig. 6). It is used much like a jointer except that the edge being worked bears against the fence and the face is on the table; this gives practically automatic assurance of squareness in edging wide boards. The two sections of a shaper fence are comparable to the infeed and outfeed tables on a jointer in that they are individually adjusted to support the dressed as well as the uncut portion of the edge.

Ends are squared on a shaper in much the same way as on a circular saw. The work must be held tightly against a miter gauge, but since the impact of the blades tends to force the work away, the use of an additional clamping device (Fig. 7) is advisable. If you don't have such a clamp, you can easily construct your own as shown in Fig. 8. The auxiliary head is a wooden bar screwed to the miter gauge; it has a block clamped on to prevent kickback and to permit finishing duplicate pieces to identical length. To determine the correct spacing for the gauge block, measure from the outer position of the cutter edge.

A similar but even simpler setup (Fig. 9) allows sizing a number of boards to the same width. An auxiliary fence is clamped to the table at the proper distance, and the work is passed between it and the cutter.

Small boards can be trimmed square on a sanding disk or belt either freehand or with the aid of a miter gauge. The former method is illustrated in the photo on page 192. The work must be kept moving uniformly along the disk. For greater accuracy use a miter gauge (Fig. 10).



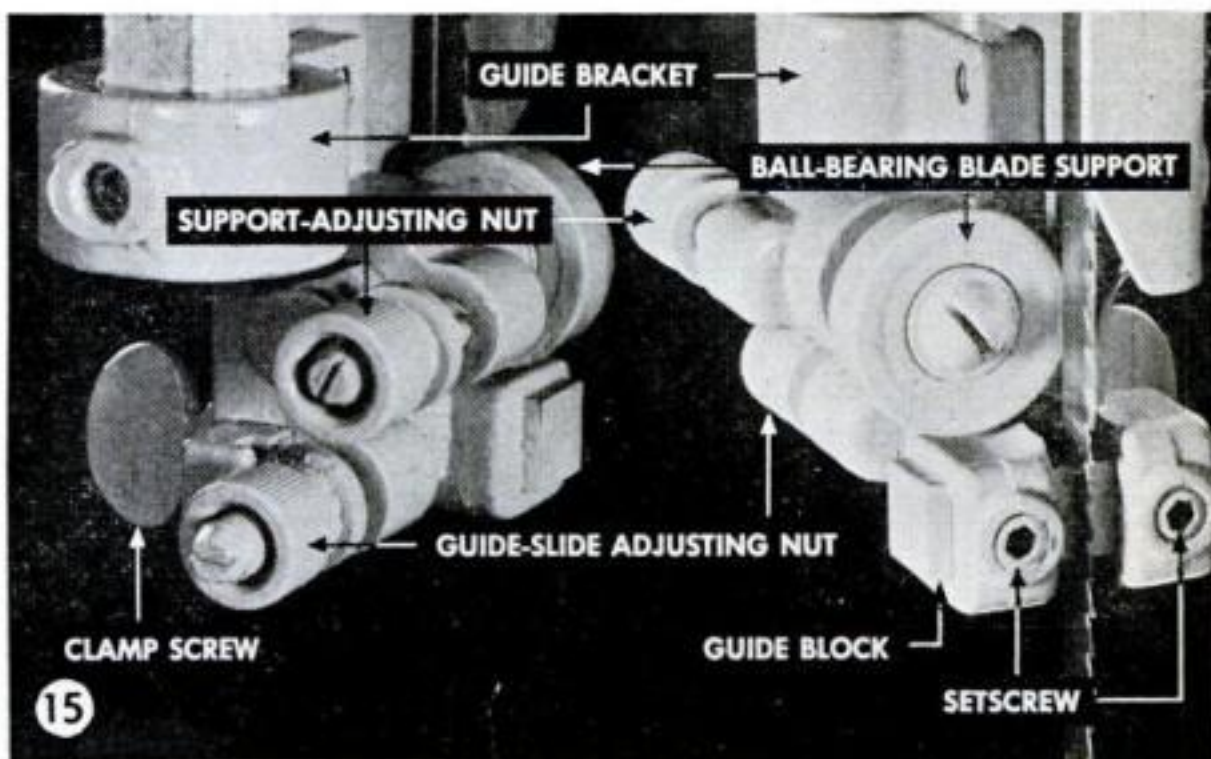
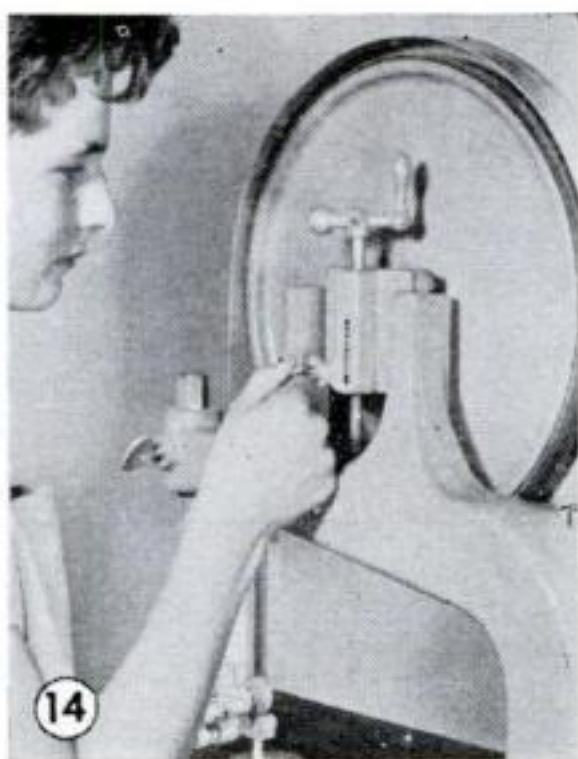


Jigsaws, or scrollsaws, are ordinarily thought of as machines for cutting curved and fretted work, but the heavier home-workshop types will square a board quite well. Straight cutting is made automatic by clamping a wooden fence to the table (Fig. 11) parallel to the line to which you are working. Bear in mind that as a result of blade "lead" the cutting center is frequently slightly to the right or left of the table center. With hardwoods or fairly thick stock you'll wish to use a heavy saber blade chucked below the table only. Teeth are set to cut on the down stroke (Fig. 12). In most cases the highest speed is used, but some tough hardwoods cut better at lower speeds. While the upper chuck is rarely

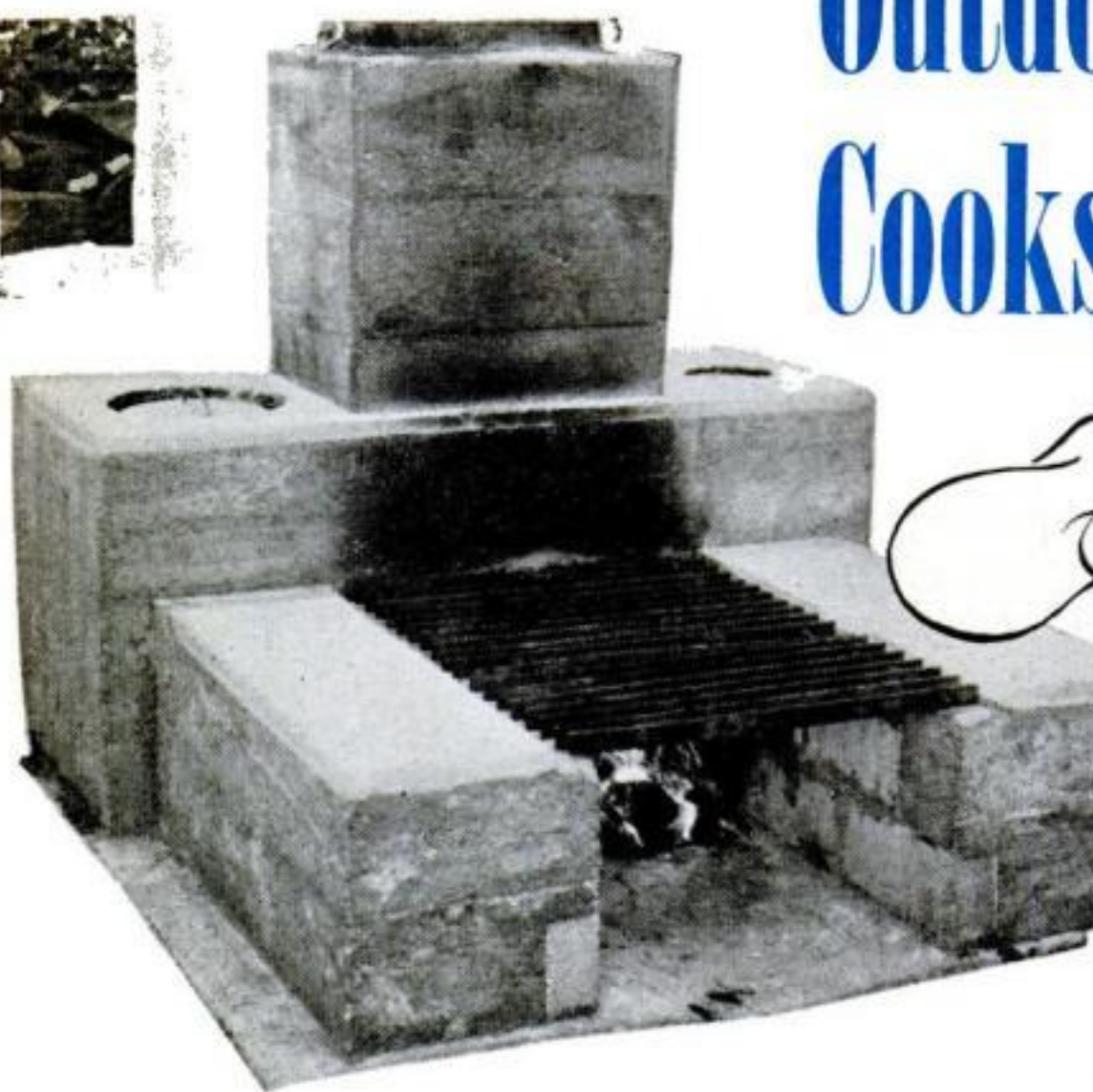
used with a saber blade, you can sometimes take advantage of the roller (Fig. 13) to support the blade if the going is hard.

A bandsaw can be used in squaring in the same way as a jigsaw; it cuts faster because the teeth travel downward continuously and at a higher speed. The blade is made to track on the wheel by the adjustment screw that regulates upper-wheel tilt (Fig. 14). Set the roller guides (Fig. 15) so that they are clear of the blade except when there is thrust on the blade in actual cutting. Guide blocks are likewise set close but free. Ends and edges cut on either a jigsaw or bandsaw will probably have to be sanded smooth before the piece is ready for use.

TO BE CONTINUED



Outdoor Fireplace Cooks Three Ways

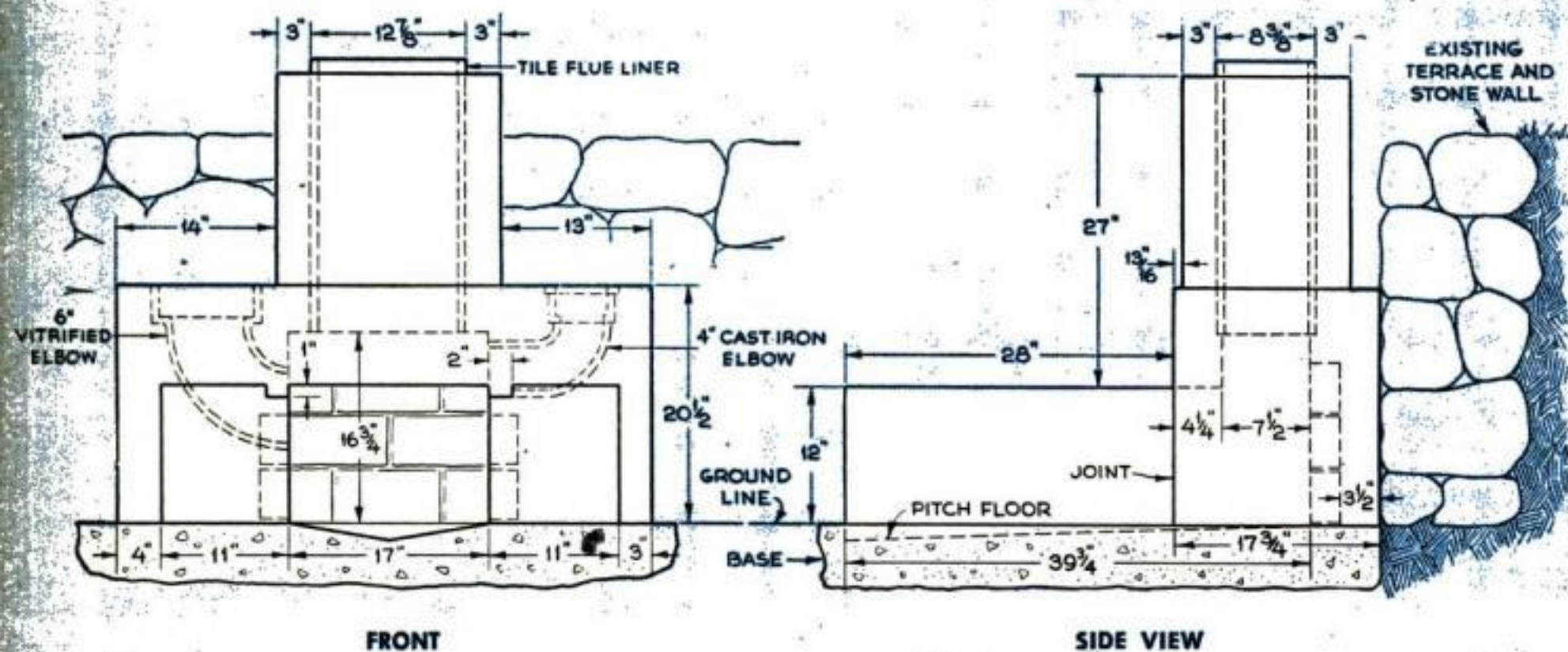


Using the two back "burners" and grill, any novice can win praise as a backyard chef.

By W. J. LaFleur

AFTER using this outdoor fireplace, you may wonder why we need all the shiny gadgets of the modern kitchen. Two back "burners," one on either side of the chim-

ney, give it a degree of heat control not usually associated with backyard cooking. With a good fire going, careful manipulation of a sheet-metal baffle atop the chimney diverts the desired amount of heat to the holes, enabling you to use one or both at



the same time you are grilling the steaks over the open fire. Concrete lids close the holes when they are not needed.

Built against an existing terrace wall, the fireplace has a firebox measuring 17" by 28"—a good average size. Although convenient for a small family supper, the fireplace also will handle the cooking for a really big party—say a barbecue for several score people.

Costing well under \$20, it was completed in about three days of labor, spread out over nearly two weeks of spare time. This permitted careful preparation of the forms and allowed adequate time for the concrete to set between four successive pours. Approximately four bags of cement and a cubic yard of gravel were required.

The ground was excavated and the base slab poured first. Then firebricks were laid for the inner wall of the firebox and the mortar allowed to set. Next came the two side blocks, then the back section around the cooking holes, and finally the encasement of the 8" by 12" tile flue liner that serves as the chimney.

Grill Rests on Rabbet

A firebrick lining saves most of the form work on the inner face of the firebox, besides adding years of life to the concrete. In laying the bricks, stagger the top row to leave a substantial corner of concrete exposed at the outer end of the firebox. Note that a rabbet along the inner edge of the side blocks allows the iron grill to rest flush with the top of the concrete, making it

easier to skid pots on or off the fire. Although the drawing calls for a 1" rabbet, this dimension should be suited to the thickness of the grill used.

The form for the firebox was built for easy removal after the concrete had set. However, if this strikes you as too much extra effort, you could leave the form in place for a week or two and then burn it out. A few large holes bored in the top under the flue will provide enough draft to burn the form boards with the first fire.

Holes Are of Different Size

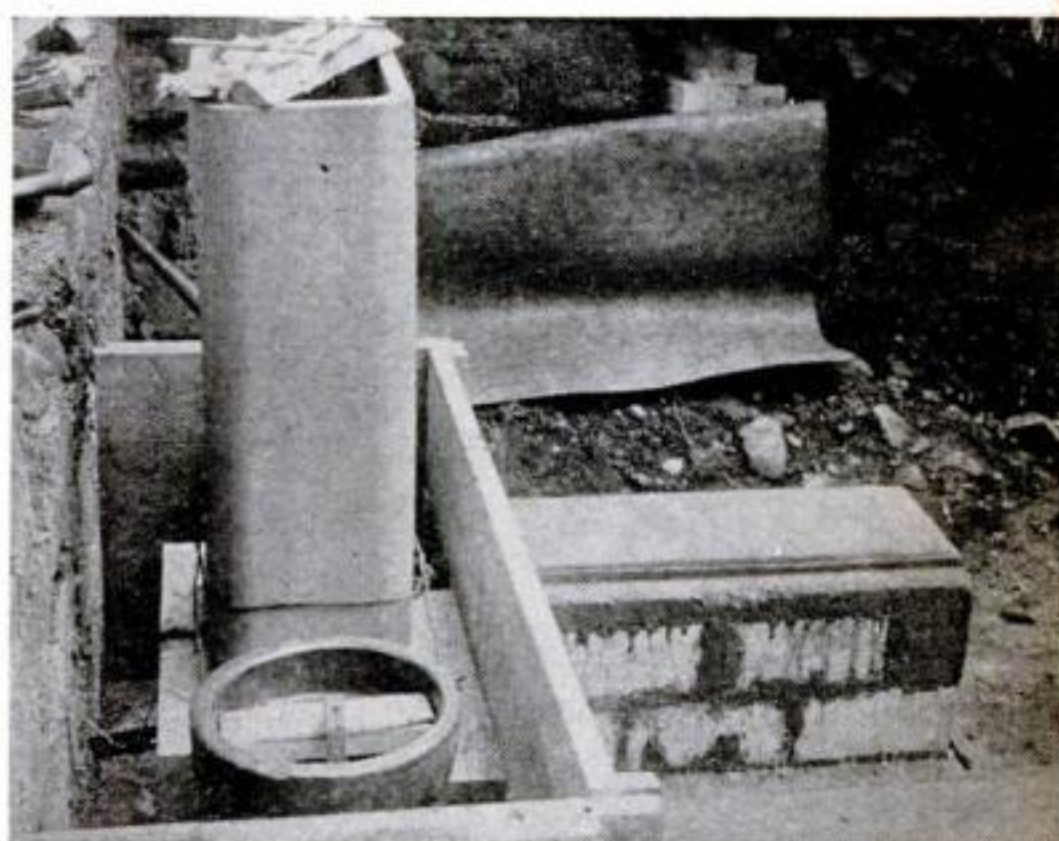
A 6" vitrified tile elbow was used for one of the cooking holes, a 4" cast-iron soil pipe elbow for the other—both being positioned to bring the top edge of the bell flush with the side wings of the fireplace. Such elbows, as well as the chimney liner, usually may be obtained from any building supply house.

Rest the lower ends of the elbows on blocks tacked to the firebox form and support the bells with wires run to the chimney tile. Rigidity is provided by another wire stretched from a hole in the firebox form up through the inside of each elbow to a cross block in the bell. A similar wire and block hold down the chimney tile.

While pouring the concrete around the elbows be sure to drop in plenty of stiff wire or small rod to reinforce the construction. When the cooking-hole section has set, build a rectangular form and also encase the chimney tile in concrete. In finishing off, do not overwork any of the top surfaces of the concrete. Using the edge of a



Elbows of two sizes are used for the cooking holes. Support these with wires and blocks.



Ready for concrete, the form looks like this. Note the cross blocks on the tile and elbow.

board, strike them off flush with the top of the form. Then leave them alone.

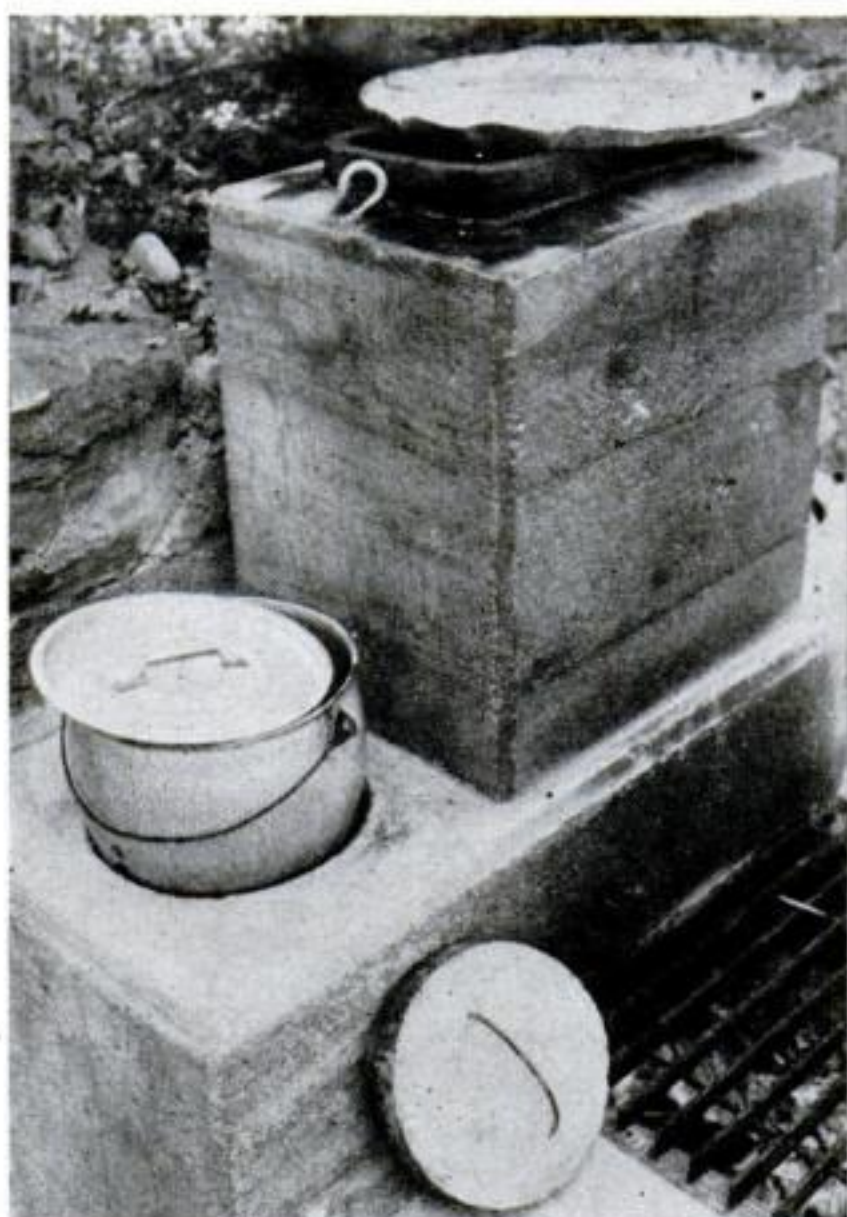
To cast concrete lids for the cooking holes, rest a disk of sheet metal on the shoulder of the elbow bell, place a snug disk of tar paper on this, and then line the sides with strips of soft cardboard. This procedure will permit easy removal of the hardened lid. Embed a piece of wire or ring in the lid as a handle.

Two-Part Grill Is Best

A two-part grill, each piece half the length of the firebox, will give the fireplace more flexibility. For a small party, you then can use only the inner half of the firebox, avoiding the necessity of stoking a small fire far back under the grill. For a big feed, both sections can be used.

Against the day when further refinement may be desired, two steel hooks were embedded in the top of the chimney encasement. To these eventually will be lashed an extension chimney, formed to fit the projecting tile and lead to an 8" diameter smoke-pipe complete with damper and spark cap.

Then the missus can preside over the back cooking holes, well below the smoke floating from the top of the stack. After a little practice the damper may be set, just so, to produce a fluffy omelet that might make any indoor cook shout with pride.



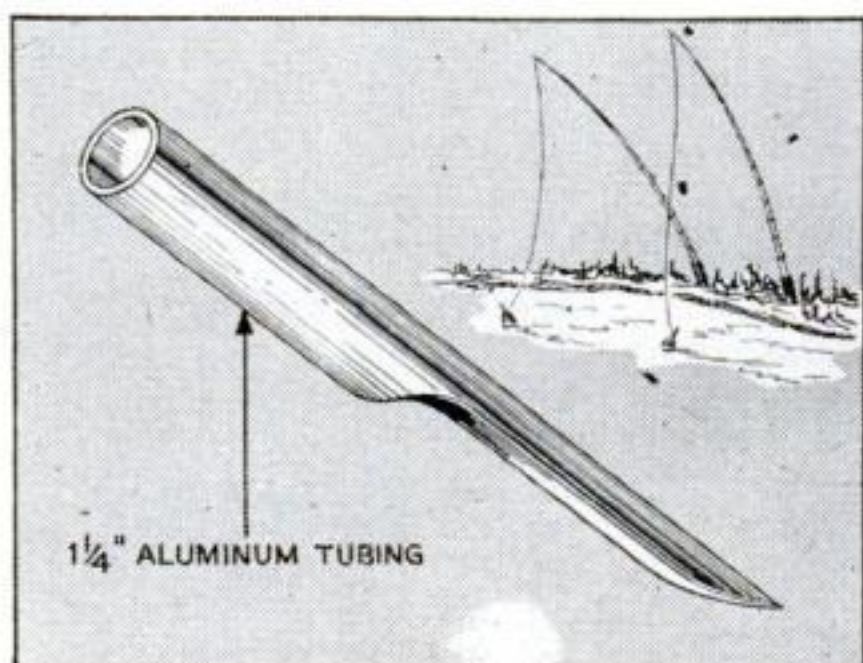
A sheet-iron baffle atop the chimney forces the desired amount of heat to either "burner."

The head man can stoke the fire as clumsily as he will, but no matter. The outdoor supper will be perfect. **END**



Bedspring Serves as Scraper

IF YOU'RE looking for a sharp-edged drag to smooth a clay tennis court, nothing can beat an old iron bedspring for the job. Attach ropes to two corners so you can drag it along. The metal edges of the frame will scrape the tops off the bumps and deposit the loose clay in the hollows. Small fry can have a lot of fun riding along to increase the weight of the drag.—*Henry K. Fitts, Morristown, N. J.*



Tubing Supports Fishing Pole

RATHER than depend on makeshift supports when you want to set up several fishing poles, try carrying along a few of these holders. Saw a 16" length of aluminum tubing down the middle for about 10" and sharpen the end. Driven into the ground, this makes a perfect socket for the fishing pole.—*W. C. Hambleton, Louisville, Ky.*

What's Your Ingenuity Quotient?

Mustachios and playing cards are an old combination as I recalled when I had trouble trimming my handlebars. A template cut from a card and held in place exposes only ends to be trimmed. It also insures that both my beauties will be balanced.—*W. G. Hykle, Montreal.*

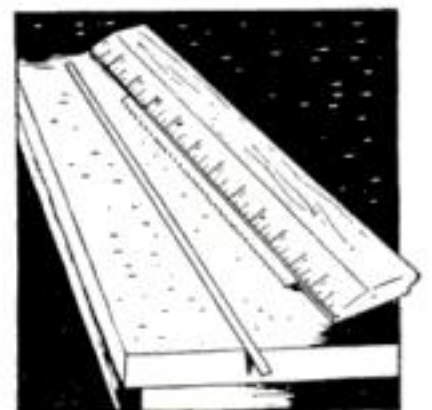


I'm no sap, so when I wanted to get some from a stand of maple trees this spring, I fastened an augur on the power takeoff at the rear of our tractor. To bore, I just back the tractor gently up to the tree; to pull the augur out, I drive ahead. It's a matter of seconds to get each tree flowing, and that's a big help when you've got a lot. Using an extra man to drive the spigots, we've mechanized our maples.—*Clarence Breitenfeldt, Marathon, Wis.*

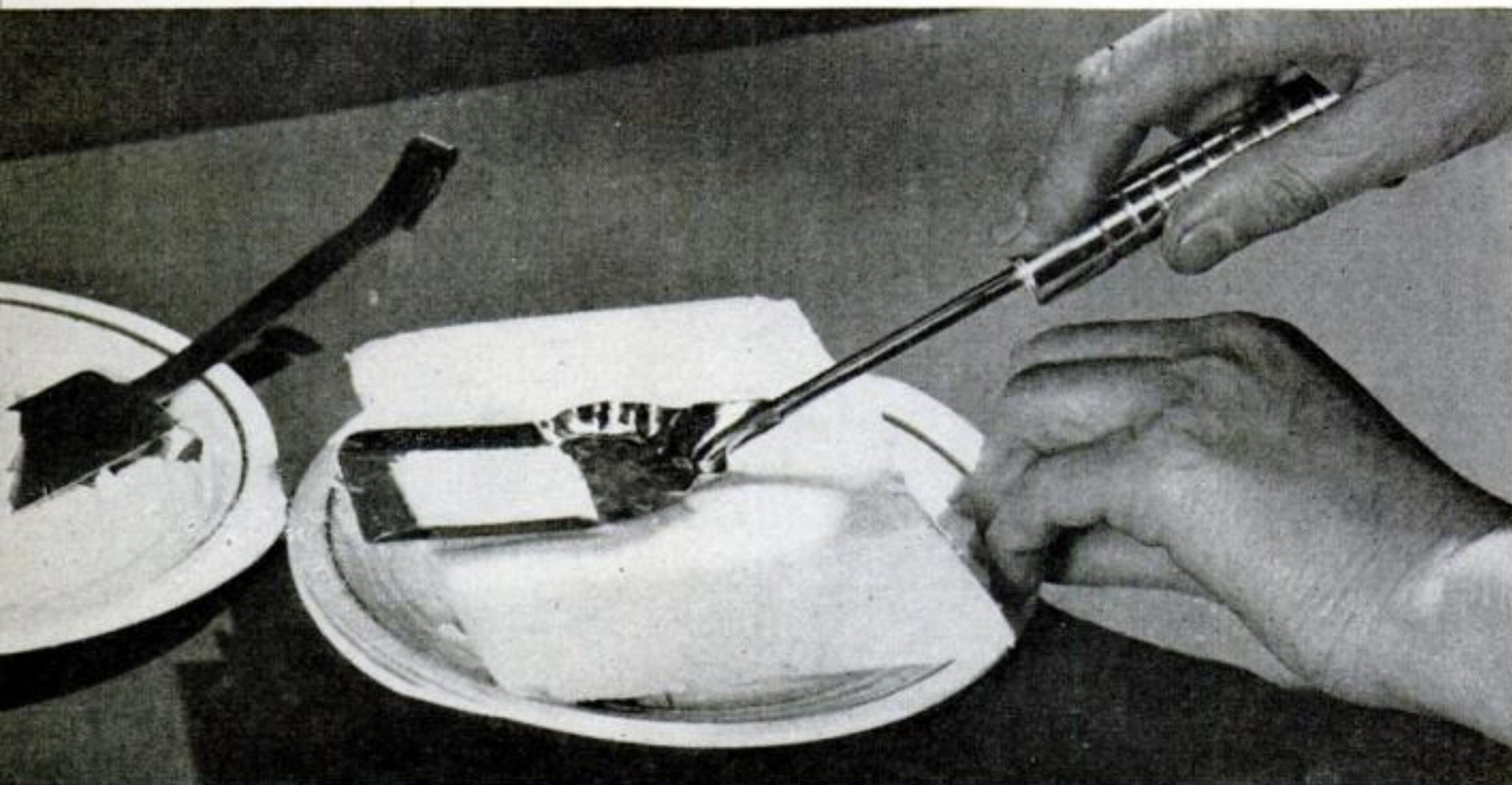
Singing the blues didn't soften one landlord's heart. He said no aerial on the roof and meant it. But we can hear the blues and everything else on the air since I fastened a length of bare wire inside the chimney as pictured.—*Arthur Trauffer, Council Bluffs, Ia.*



There's no rule that says a broken piece of a small hacksaw blade can't be used to cut a groove when the job has to be done and there is no other tool available. To hold it stiff, I extracted the brass edge of a ruler and substituted the blade fragment. The brass edge was later cemented back in place.—*M. C. Everett, Great Neck, N. Y.*



Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.



Snack Server Has Slicing Edge

THE Waldorf never served neater cheese snacks than you can offer your guests with this combination slicer-server. It cuts even, thin slices of cheese, and deftly places them on plates or sandwiches.

This handy gadget is made in two parts that can be used together or separately. You can use common steel for the knife and spatula, though stainless is perhaps the ideal material. The shovel, made of sheet about .025" thick, must be hard enough to hold a good cutting edge. The spatula, of

sheet about .030" thick, must be springy.

To form the shovel-like slicer, trace the pattern (Fig. 1) on sheet metal and cut out. Smooth the edges and cut the slot by drilling end holes with a $3/32$ " bit and sawing between them with a jeweler's saw. True up the slot with a flat file, but do not sharpen the cutting edge (the forward edge of the slot) until after assembly. If you use hardened stainless steel, anneal the handle end of the blank by heating white hot and quenching in water. Bend up the edges of

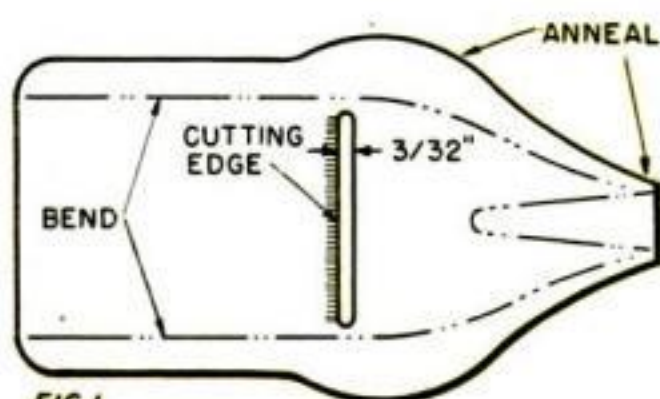


FIG. 1
KNIFE BLANK

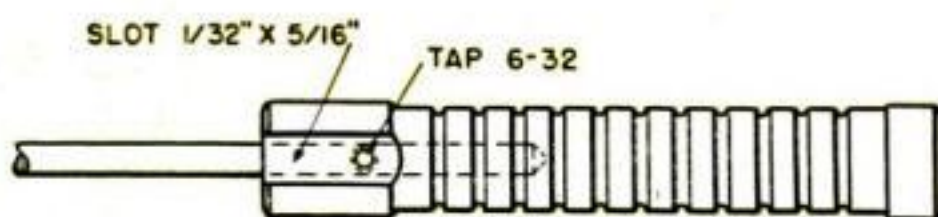


FIG. 2 HANDLE

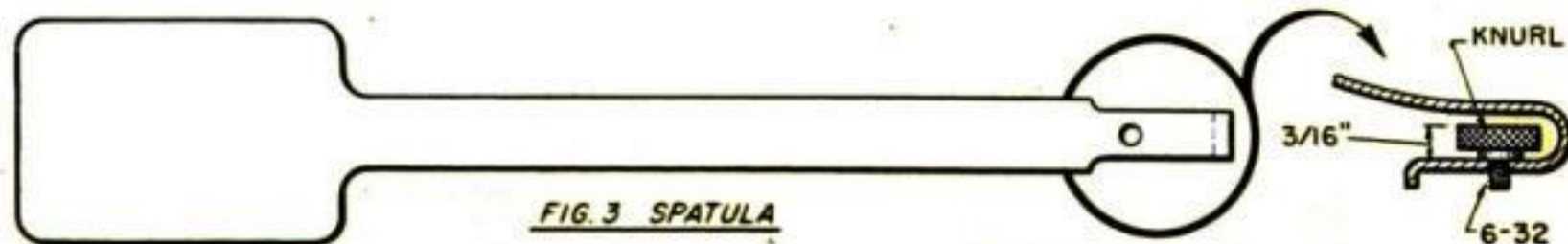
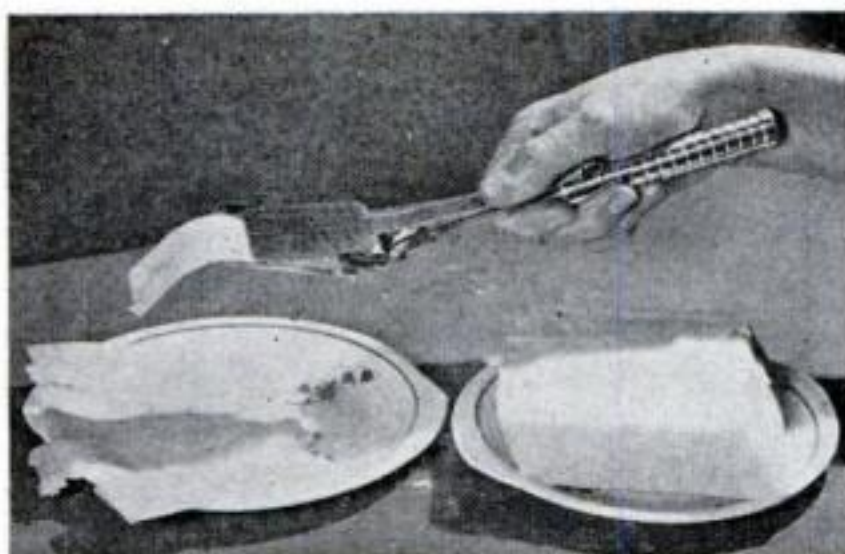
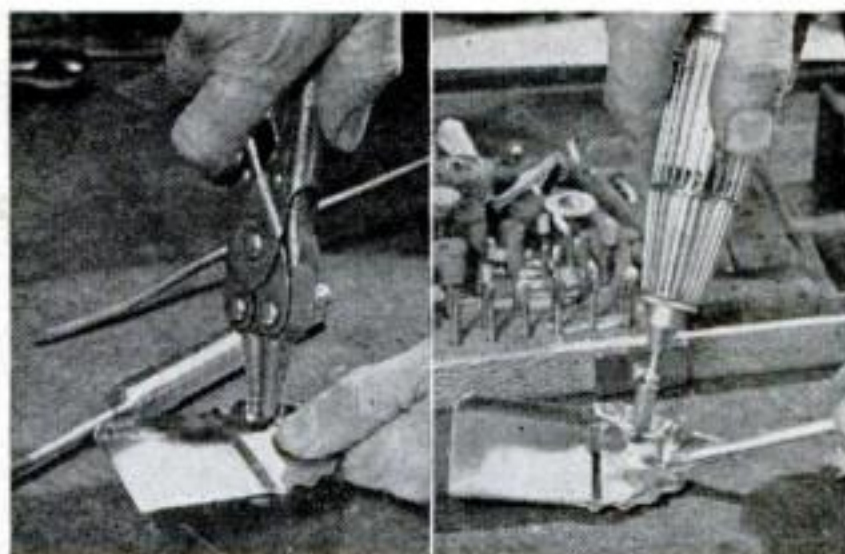


FIG. 3 SPATULA

SCALE: HALF SIZE



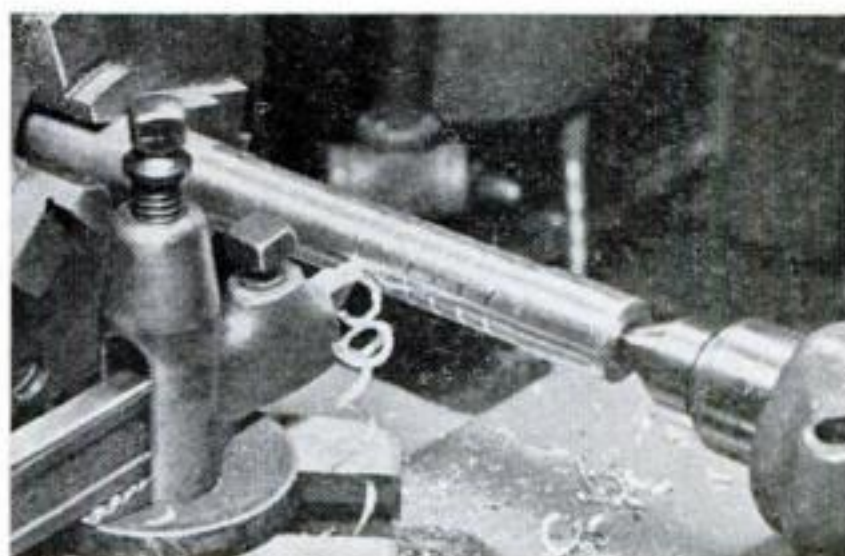
The attached spatula helps pick up and serve food that the knife edge has neatly sliced off.



Round-nosed pliers crimp a stove-shovel contour that can be buffed with a hand motor tool.



Careful sharpening of forward edge of slot in shovel enables it to slice even, thin portions.



This handle was turned from aluminum rod, but plastic, wood, or other materials can be used.

the shovel forward of the slot in a vise. The curved edges are then crimped pie-crust fashion with round-nosed pliers. Shape a recess for the $3/16$ " stainless handle rod.

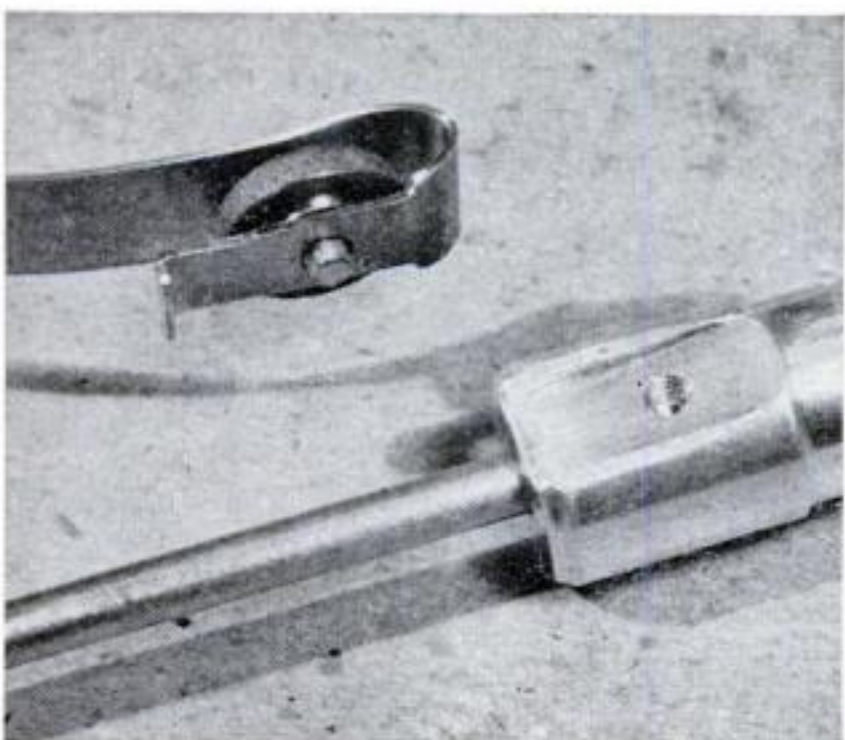
After shaping, polish the steel to remove scratches and tool marks. A hand grinder with a rubber-bonded abrasive wheel in it, as shown in one of the photos, does a quick job.

As shown, the handle is $3/4$ " aluminum

rod with decorative grooves turned in. Of course you could use hardwood, plastic, or even bone instead. Drill the handle hole slightly undersize to $1\frac{1}{2}$ " depth and ream out $3/16$ " to $1\frac{1}{4}$ " depth. Drive the rod, which should be about $4\frac{1}{2}$ " long, into the reamed hole. Grind or file the end to form a flattened tip and hard-solder to the shovel head. Mill or file a slot for the spatula on the shovel handle (Fig. 2).

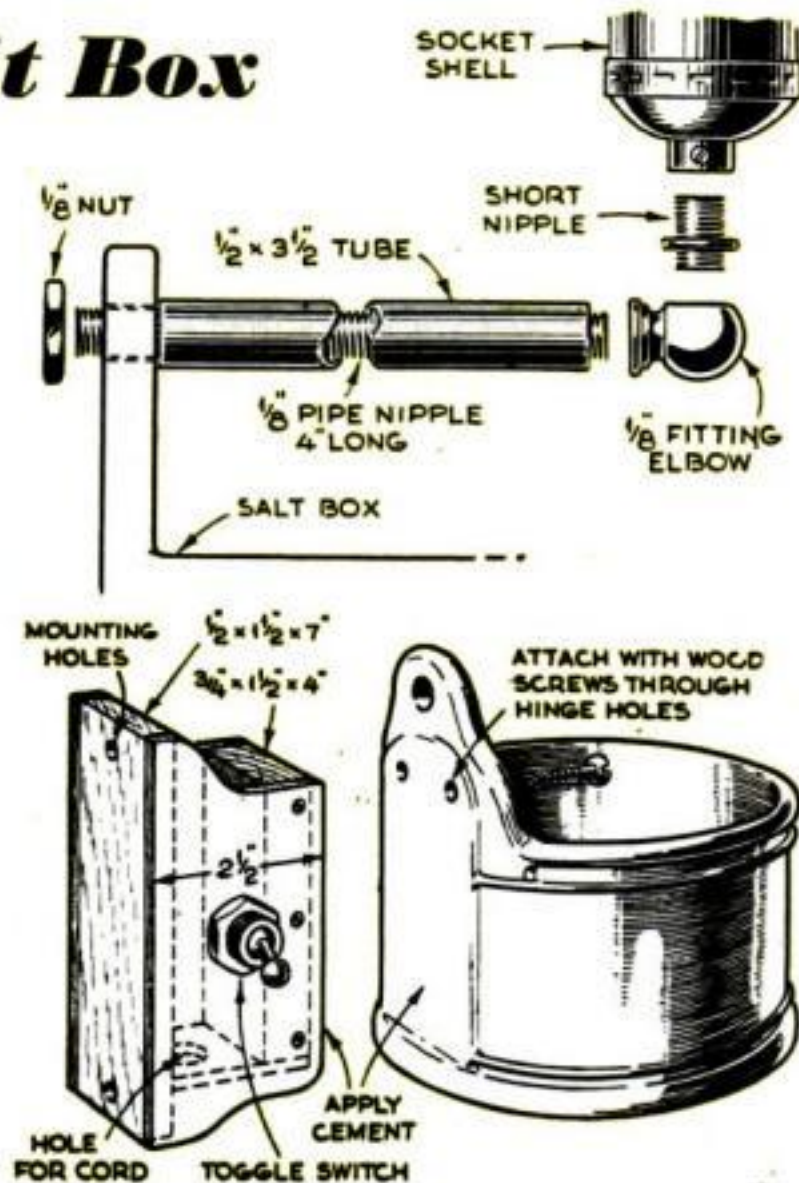
Rough out the spatula (Fig. 3) with a narrow chisel and smooth the edges. The spatula handle is $7/16$ " wide to within about $3/8$ " of the tip, where it narrows to $5/16$ " to fit the handle slot. Bend $3/8$ " of the narrow tip at right angles to hook over the end of the handle. About $1/2$ " from the bend, drill a hole to clear a 6-32 screw. Drill a matching hole in the shovel handle slot with a No. 36 bit and tap 6-32. Make a $1/2$ " knurled head, tap it 6-32, and hard-solder it to a screw just long enough to hold the spatula firmly on the shovel. With the screw in place, bend the spatula handle as shown.

File the forward edge of the cutting slot to knife sharpness, and bend up the other edge about $1/16$ " to expose this knife edge.



A knurled-head screw in spatula handle quickly attaches it to shovel for deft, no-slip serving.

Light from a Salt Box



SOME of the old salt boxes available in antique shops and secondhand stores are ideally suited as bases for small lamps—for use on a table or desk or, with an appropriate bracket added, as a pin-up lamp in dining room or breakfast nook.

These old boxes were made of wood or, as in the case above, of glazed and decorated pottery. Except that you'll usually want to remove the hinged lid (if it's still intact), both types are adaptable with little or no change as lamp bases. An elbow fitting to support the light fixture may be clamped in the hole at the back by which

the box originally was hung on the kitchen wall. The holes for the lid hinge, if located at the back as in the example above, may be utilized in attaching a wall bracket.

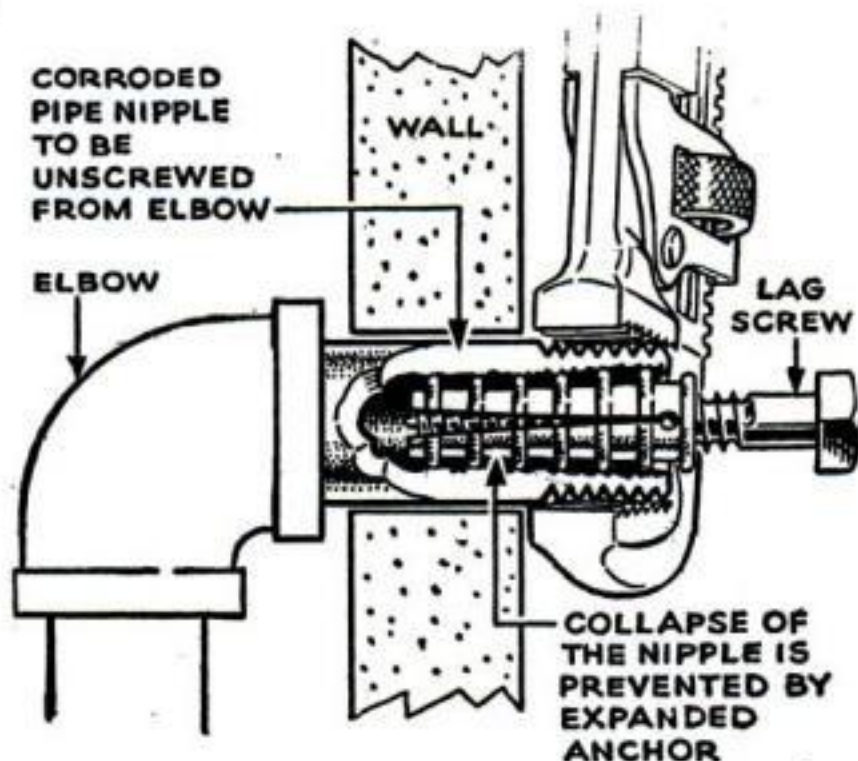
In the lamp above, clamping action exerted when the $\frac{1}{8}$ " nut is turned up keeps the fittings in place, and a socket shell with built-in switch was used. When the wall bracket is added, however, it is more convenient to install a toggle switch. A black-trimmed shade was chosen to harmonize with the black-painted fittings and the word "salt." The shade is 10" in diameter at the bottom.—R. P. Stevenson, Manhattan, N. Y.

Drawing Guide Adjusts to Any Desired Curve

DESIGNED to simplify the work of draftsmen, this new drawing tool can be set to practically any desired curve, including reverse curves. The tool is a product of the Cook Specialty Co., Green Lane, Pa.

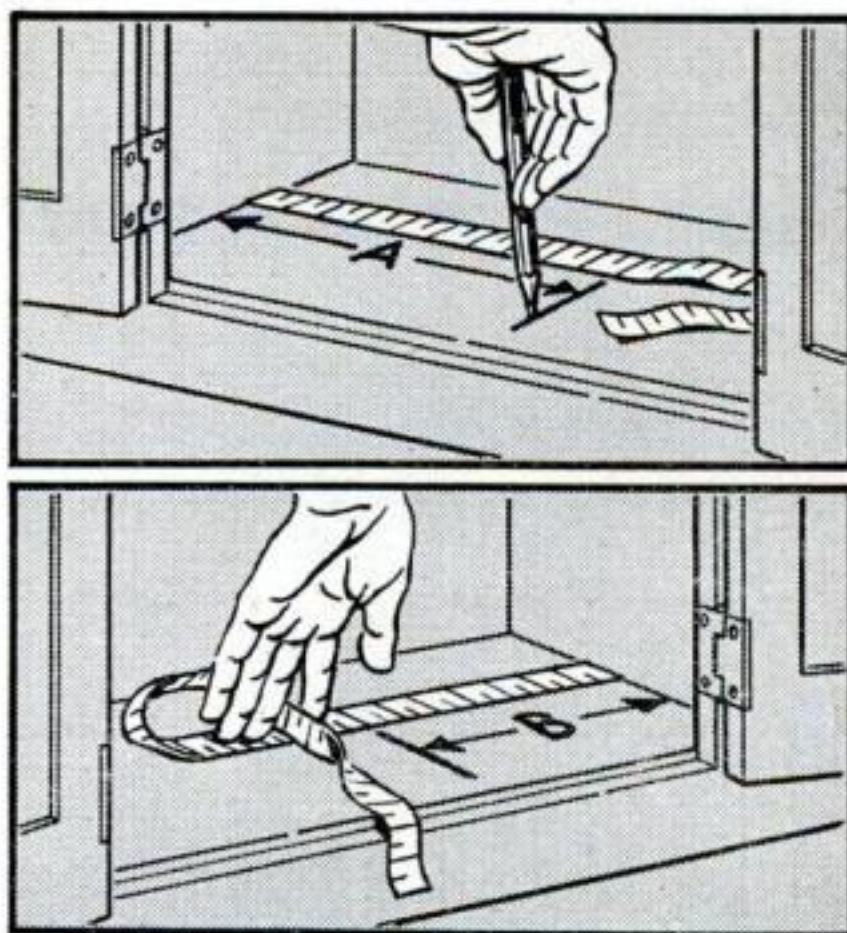
It consists of a 12" base plate with a straight slot in one end and a curved slot in the other. Adjustment screws in these slots hold any one of four preformed wire guides. By sliding either or both adjusting knobs along the slots, a guide may be brought to the desired curve. Either a ruling pen or a pencil may be used.





Plug Helps Remove Nipple

A LAG screw and expansion plug can help you out of what might be a difficult, time-consuming job—replacement of a rusted, leaking faucet nipple that sticks out of the wall only an inch or so and is too weak to stand the pressure of a Stilson [®] wrench. File the plug to fit inside the nipple, insert the lag screw, and turn until the plug has expanded to a firm grip inside the nipple. Even though the nipple wall has rusted thin, you can now use a wrench to back it cautiously out of the elbow. The plug supports the wall.—Garrett Kemp, Dallas, Tex.



Taking Inside Measurements

TAKING the exact inside measurements of a cupboard or window is easy, even with a stiff steel rule. Just measure from one side the distance to about the center of the space (A in top sketch) and make a thin pencil mark. Then move the rule over and measure the distance from the other side to the pencil mark (B in lower sketch). The sum of A and B is the total inside dimension.

Light Over Stoker Hopper Shows Coal Impurities

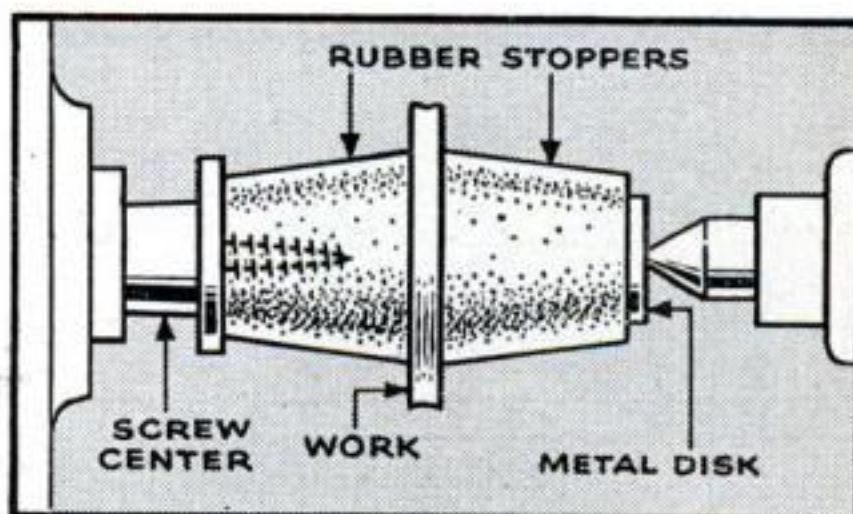


A BRIGHT light over the stoker hopper in the furnace room will repay the trouble of putting it in every time you have to fill the hopper. It will speed that job, and also help you locate rock and slate in the

coal that might jam the stoker worm. I use a porcelain drop socket with a reflector that throws a concentrated beam.

The light should be hung squarely over the hopper opening and low enough so that it will not shine directly in the eyes. It is controlled by a three way switch that also operates the stoker. The switch is wired to turn the stoker on and the light off when the handle is thrown up. With the switch handle down, the light is on and the stoker off. This arrangement serves as an automatic reminder, the light warning if the stoker has not been switched on after the hopper

has been filled. Mark the switch to inform others of the combination control.—Ernest M. Woerner, Eureka, Ill.



Rubber Stoppers Hold Disks

DISK edges can be turned easily in a lathe between two laboratory rubber stoppers. Mount a wood-turning screw center, and slip a one-holed stopper over it. The tailstock, acting through a center-punched disk, supplies pressure to a second stopper.—D. H. Matheson, Hamilton, Ont.

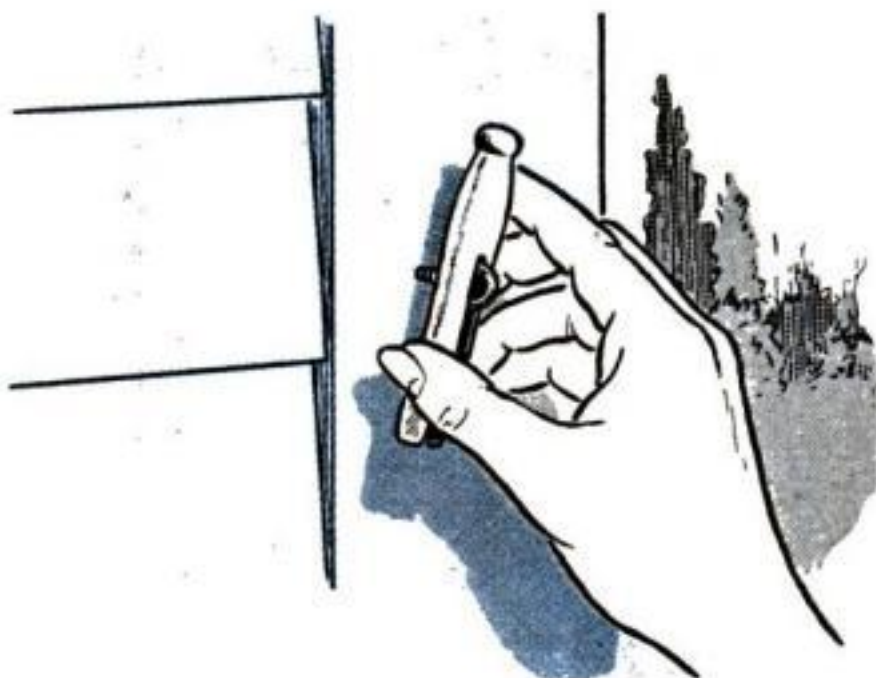
Keeping the Home Shipshape



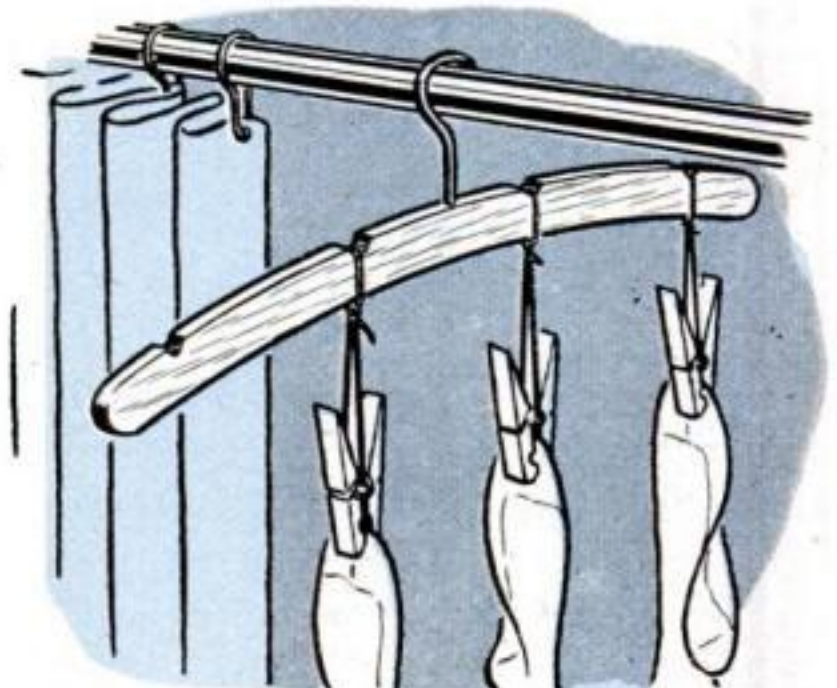
Fumbling with packages while you try to open the latch of a gate is unnecessary. Instead, build a shelf or platform on top of the gate to hold them. Brace it with shelf brackets.



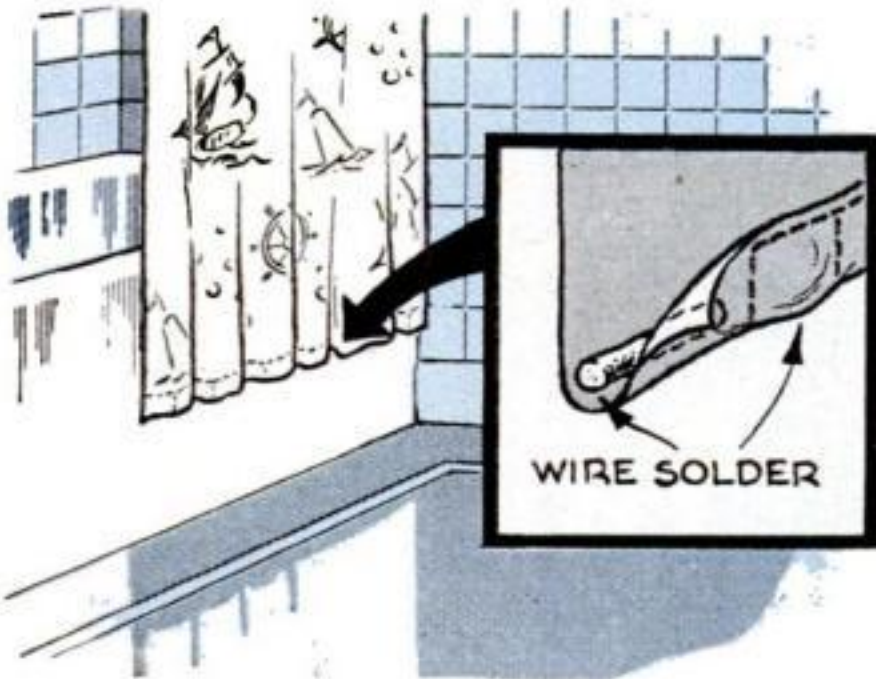
Dust collects easily on ironing-board covers, and just as easily gets into the clothes you press. Use the paper garment bags your cleaner sends dresses home in to protect the board.



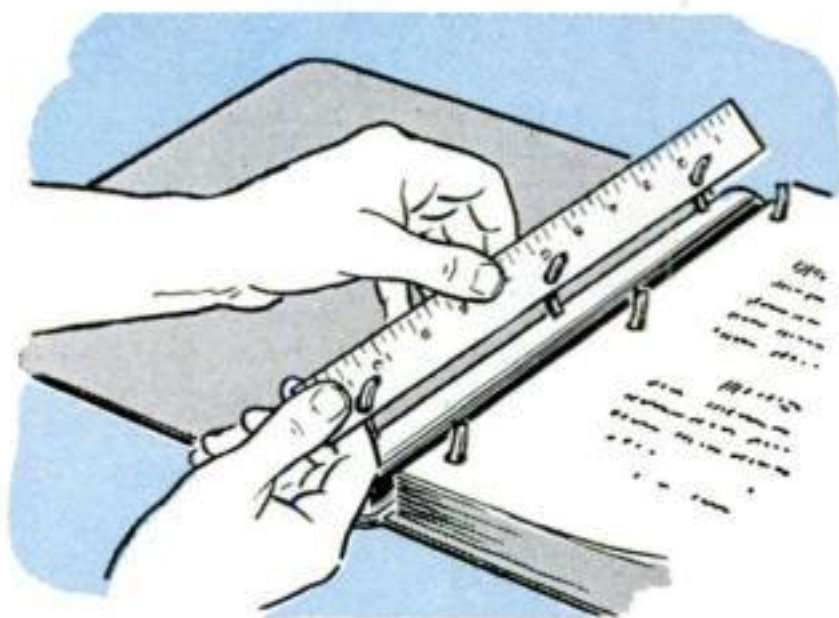
There's no need to turn out the tool box when you have to drive or tighten screweyes, cup-hooks, or the like. A wooden clothespin used as shown provides ample leverage for the job.



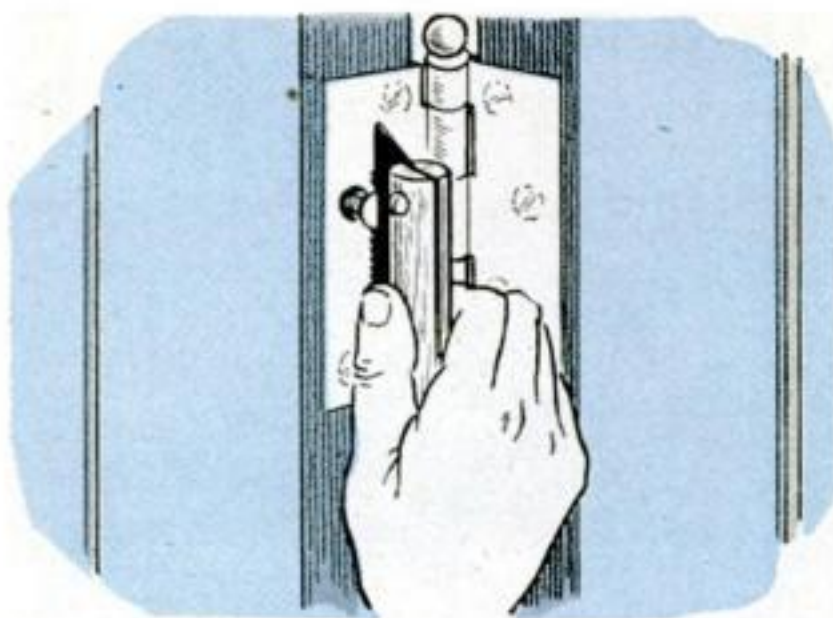
A stocking drier can be made from spring-type clothespins and a wooden hanger. File notches in the hanger, run a string through the spring coil of each pin, and tie to the hanger.



Shower curtains, especially the newer plastic type, tend to billow and blow when a window is opened or the water turned on. Tucking small weights into the hem will hold them still.



The student who occasionally needs a ruler can keep one at hand by drilling holes in a thin plastic, metal, or wooden ruler, and slipping it over the rings of his loose-leaf notebook.



A piece of hacksaw blade clamped in a dowel is a good tool for removing paint-covered screws. Use the pointed end to get a start for the screwdriver, and then clean the slot completely.



A curtain-rod holder of the type shown makes an excellent hook for a key ring. If the friction lug is bent out a trifle, there is little danger that the ring will be dislodged accidentally.

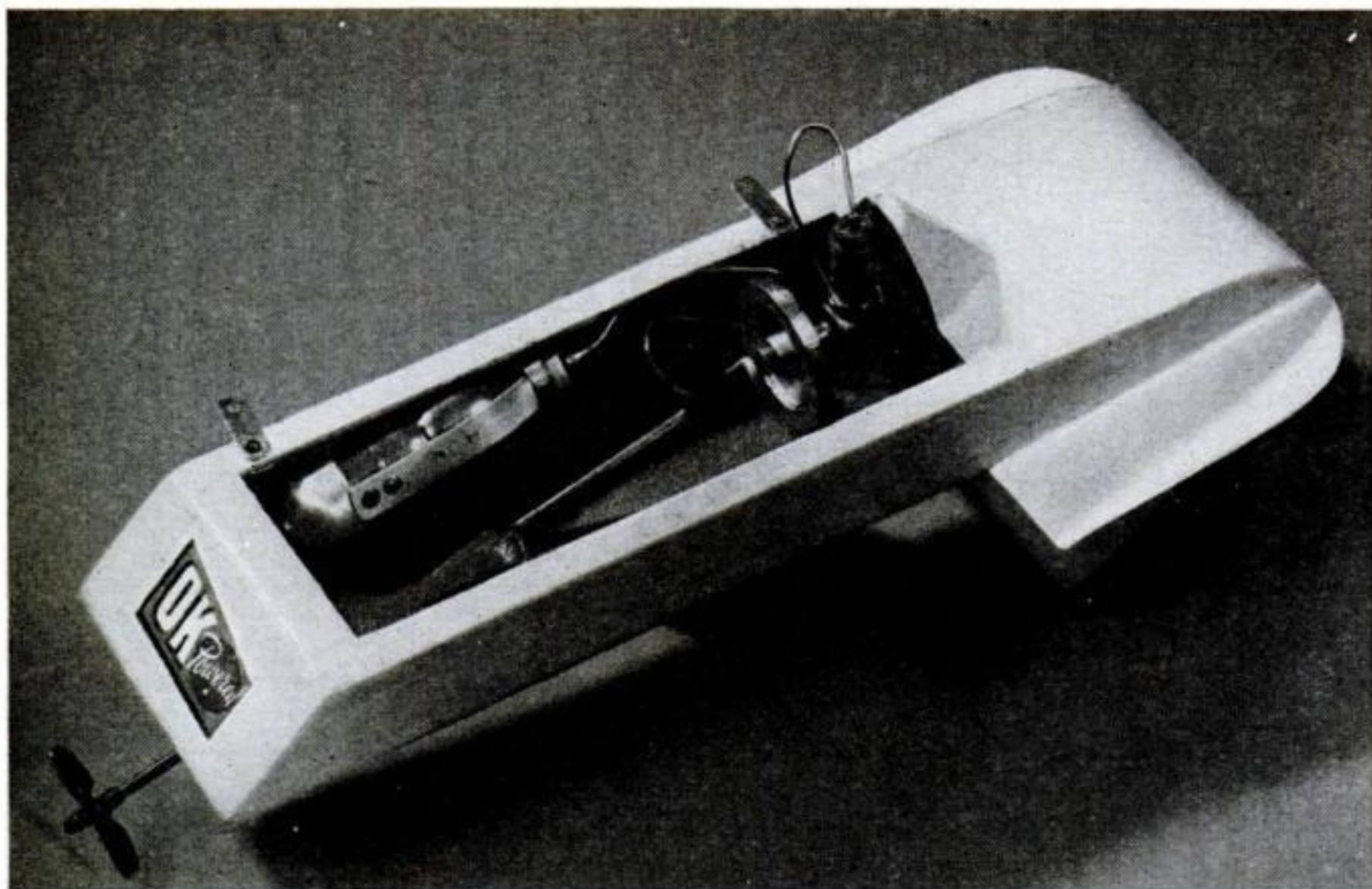


A worn-out broom may not sweep out much dirt, but as a shoe scraper it can keep some from getting into the house. Cut the bristles short, and nail the broom to the back step.



Need more light for shaving? Cut a mirror to fit inside one frame of a window like that

shown. Attach it securely with clear cellulose tape. Surrounding panes will give ample light.



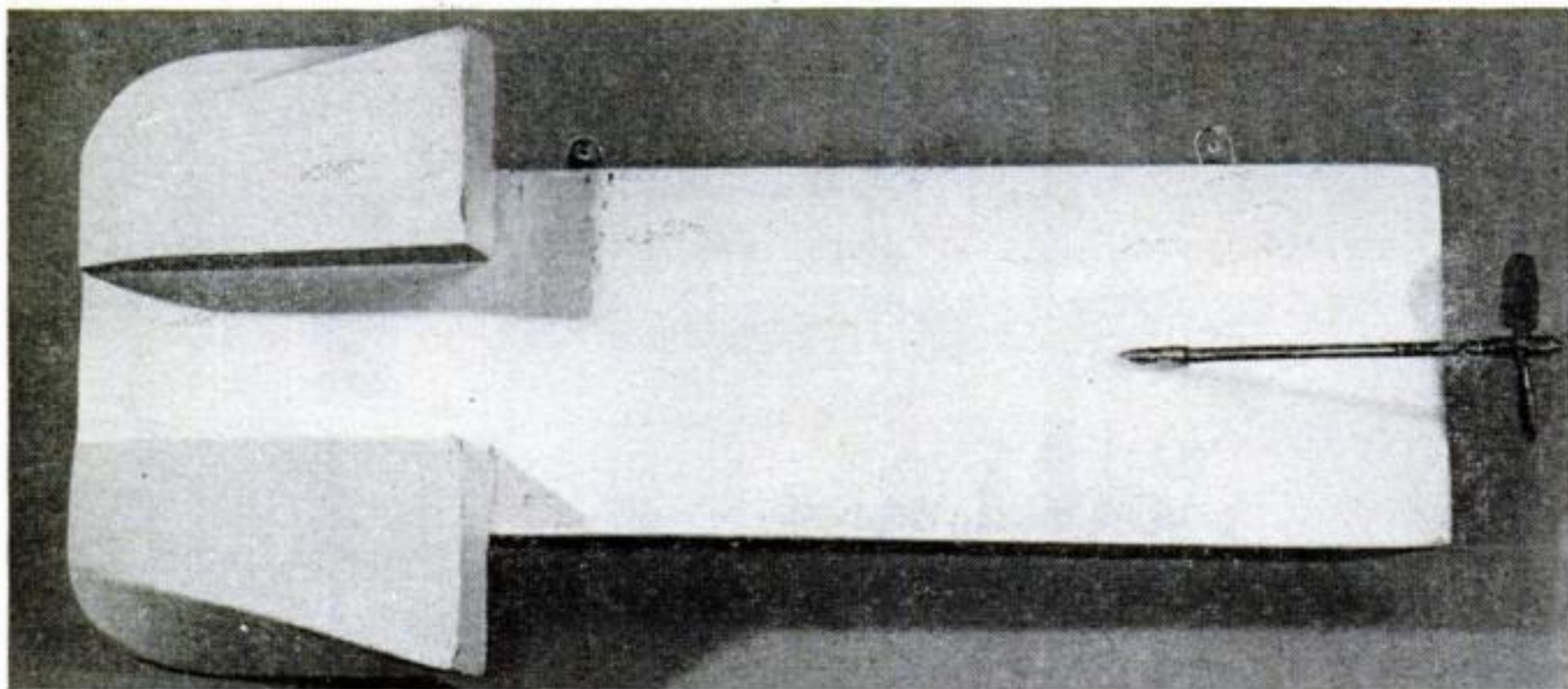
Weighing only a few ounces, this shipshape little craft skims the waves on soda-fizz power.

Whizzer...A Fizz-Powered Speedboat

THOSE bubbles that put ginger in your soda pop shove this midget speedboat along at a smart clip. Powered by a tiny expansion engine and carbon dioxide cartridges, the model is ideal for the youngster who can't yet deal with a gas job but wants

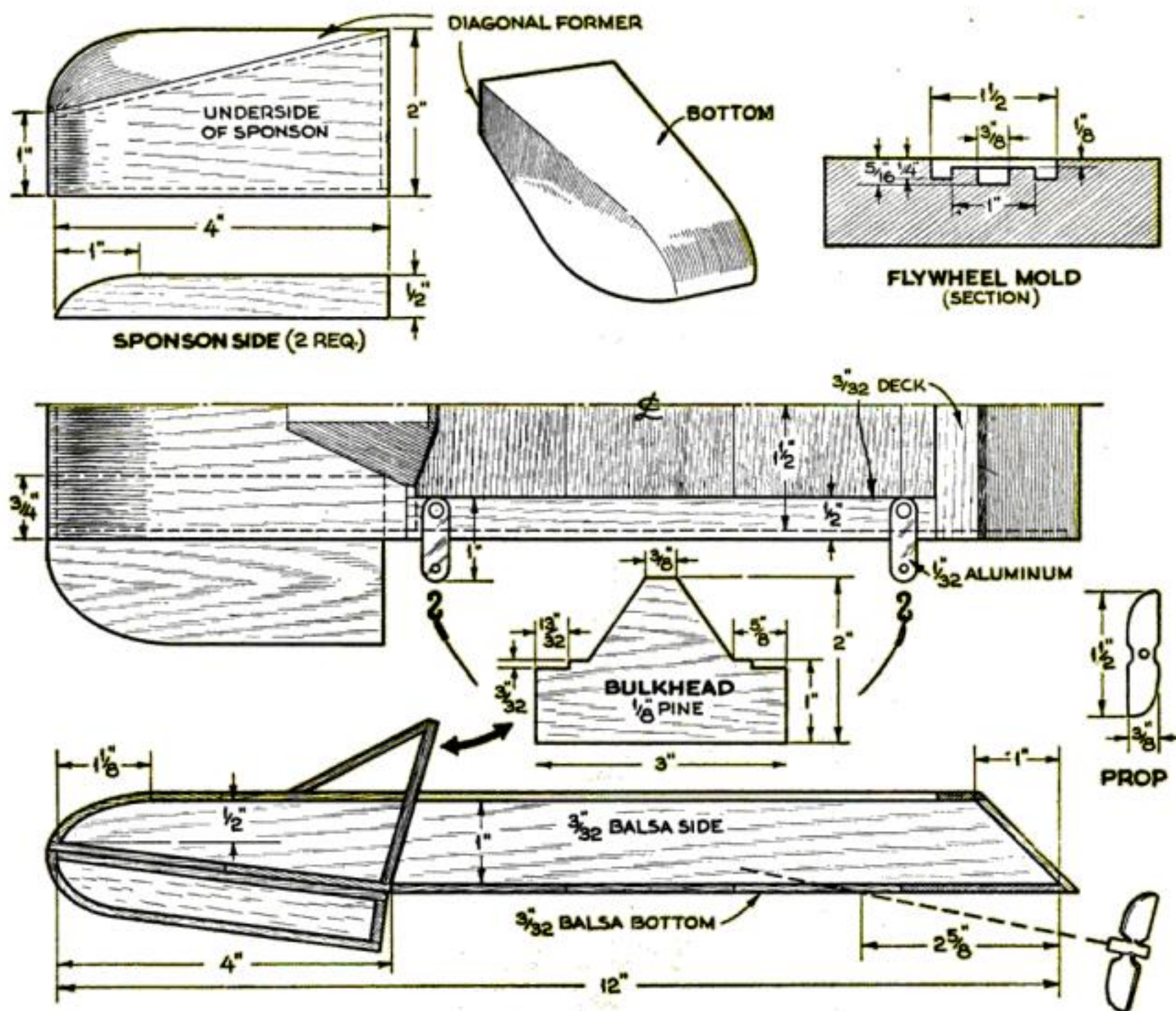
"a real engine." His father can turn it out in a hurry or supervise Junior at the job.

An adaptation of the Ventnor design, the hull is built in three parts. Begin by cutting the two sides from 3/32" balsa sheet. These are 1" wide, with the point of the bow



Turned over, the hull looks like this. Note the boxlike sponsons with their flared outer sides.

The shaft is aligned with the centerline of the hull. No shaft strut or other brace is required.



just midway. Cut both at once to be sure they're identical. Shape the bulkhead from $\frac{1}{8}$ " pine or plywood and cement it and the $\frac{3}{32}$ " by $1\frac{7}{16}$ " by 3" balsa transom between the sides. Cement $\frac{3}{32}$ " sheet balsa over the bow curve back to the bulkhead; then add the strut forward of the bulkhead and cover with sheet on both sides. Cement on the bottom and the gunwales.

For the two secondary hulls or sponsons, cut identical sides, tops, and ends. Cement these into boxlike structures and attach the bottoms, propping these up with tiny struts to maintain a uniform curve forward. Be sure they're square and that you've built one right and one left sponson. Apply cement freely to the edges of the open sides and press on $\frac{1}{16}$ " sheet balsa so that it takes on the curve necessary. When the cement is dry, trim the edges. Cement the sponsons to the main hull, properly aligned with it and each other. Cover the hull outside with model-plane tissue held on with dope. Finish with four coats of colored dope. Protect the interior with several coats also.

If you can't find a suitable flywheel, turn

a mold in dry wood to the dimensions shown. Remove it from the lathe but not from the faceplate, pour in type metal or solder, and remount in the lathe to face off and drill.

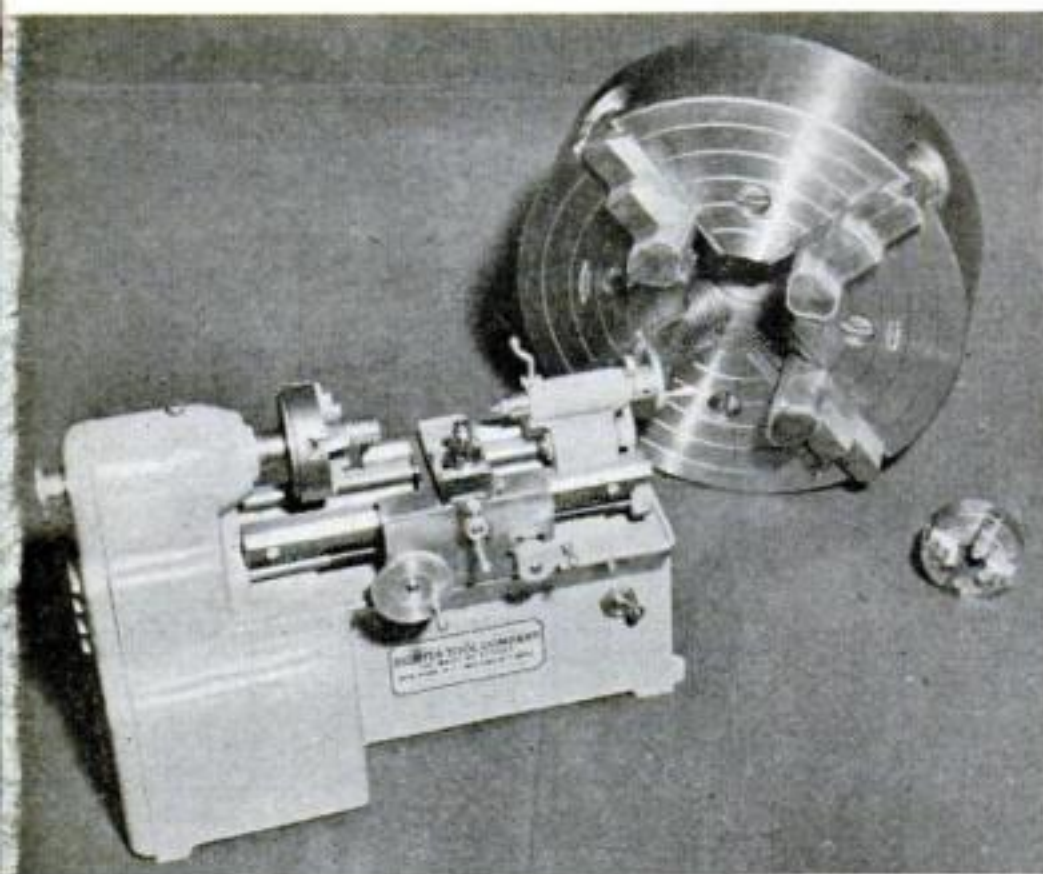
Mount the engine with small wood screws so that the flywheel clears the bottom. Cement a 2" length of $\frac{1}{8}$ " i.d. brass tube in a hole $2\frac{3}{8}$ " from the stern and build up composition wood around it; be sure it's lined up with the engine shaft. The propeller shaft is $\frac{1}{8}$ " brazing rod. Cut the propeller from sheet copper or brass, bend it to shape, and solder it on between bits of tubing.

For a universal joint, cement a bit of Neoprene ① gas-line tubing on the engine and prop shafts after cleaning them with dope thinner. Locate the cartridge holder under the gunwale on the left side (if the prop is to run counterclockwise) to counteract engine torque. Attach tether clips with 2-56 screws and nuts, and use a line 15' long.

At some high-speed valve settings you may have to use a strap around the flywheel to start the engine. Never try to do so by turning the propeller with the fingers.—Roy L. Clough, Jr., Terryville, Conn.

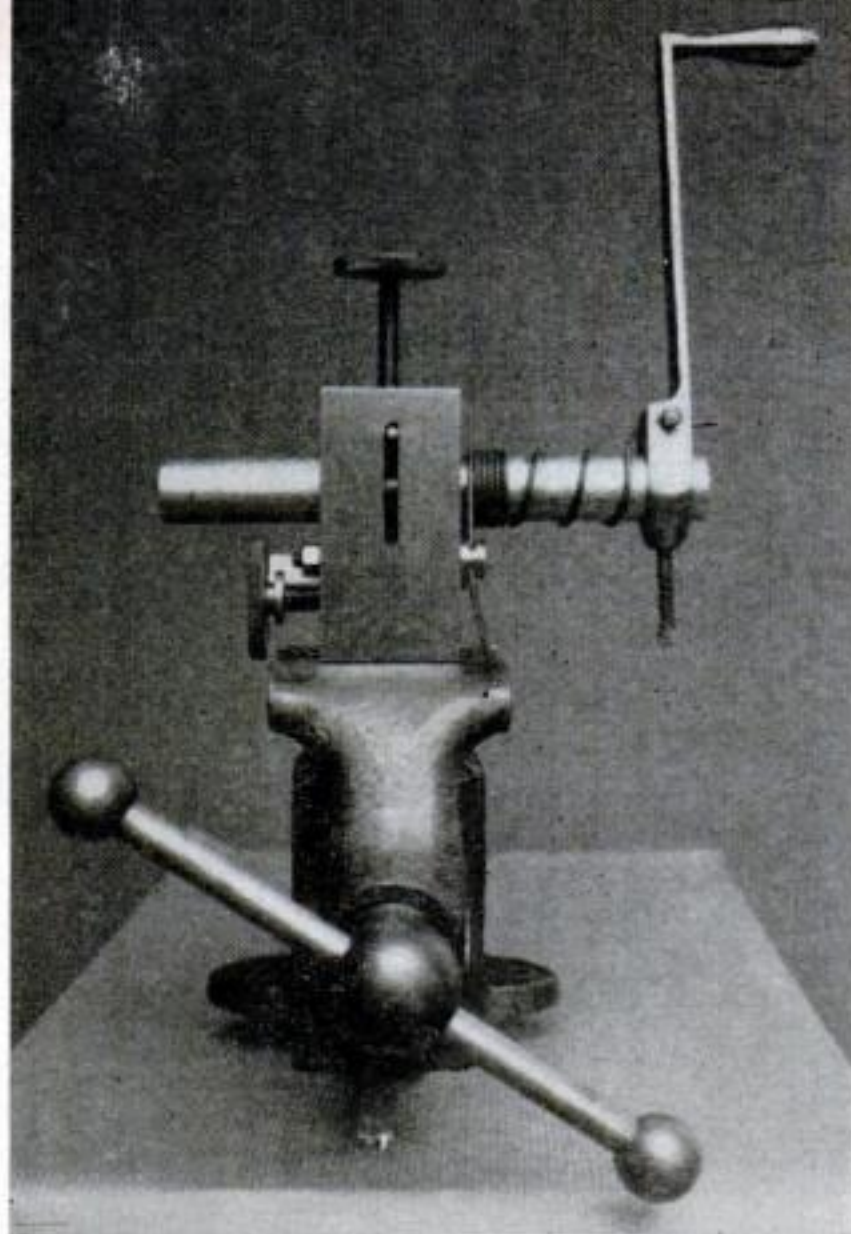


Tool Rack Adjusts. Here's a tool rack consisting of hardwood blocks that slip firmly into an aluminum back strip attached to the wall or bench. Various drilled, counterbored, and slotted for most of the small hand tools you'd commonly use, the blocks may be assembled on the back strip as desired. Priced at about \$2, the rack is a product of Davis Development Company, of Colorado Springs, Colo.

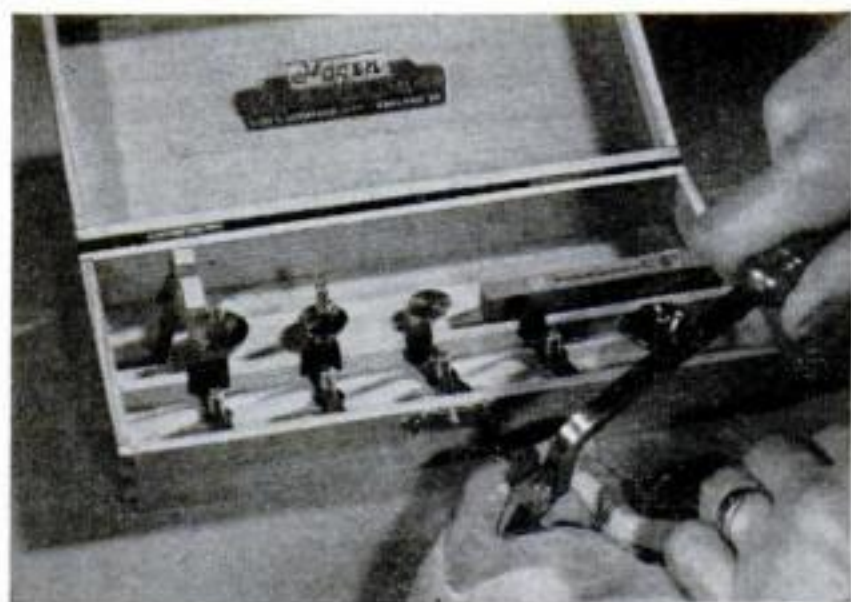


Lathe Only 9" Long. Designed for precision work on small parts, this midget lathe is driven by a 115-volt AC motor mounted in the base, and has a spindle with a $3/16$ " through hole. Maximum swing over the bed is 2" and maximum distance between centers is 3". Power carriage feed, two spindle speeds, and ground V-ways are other features. Small Machines, Inc., of Los Angeles, is the maker.

208 POPULAR SCIENCE



Winds Springs by Hand. Short lengths of drill rod are used as mandrels in a hand spring winder produced by the Blaner Manufacturing Co., of Sharon, Pa. Designed with an undercut so that it may be clamped in a bench vise, the tool will produce either close springs or compression springs, depending on whether the crank is set close in or far out on the mandrel. The winder is made in four sizes.



Carving Set Uses Round Blades. This new carving set consists of a handle and eight cutters, three of them conical. Since each cutter may be mounted either ahead or behind the curved end of the handle, the tool may be used in the manner of either a chisel or a draw knife. When a circular cutter gets dull in one spot, it may be rotated slightly to a sharp spot. Hagen Engineering, Chicago, makes the set.

How I Built a Milling Machine

Semifinished castings enable a home machinist to turn out a precision tool, using a lathe and drill press.

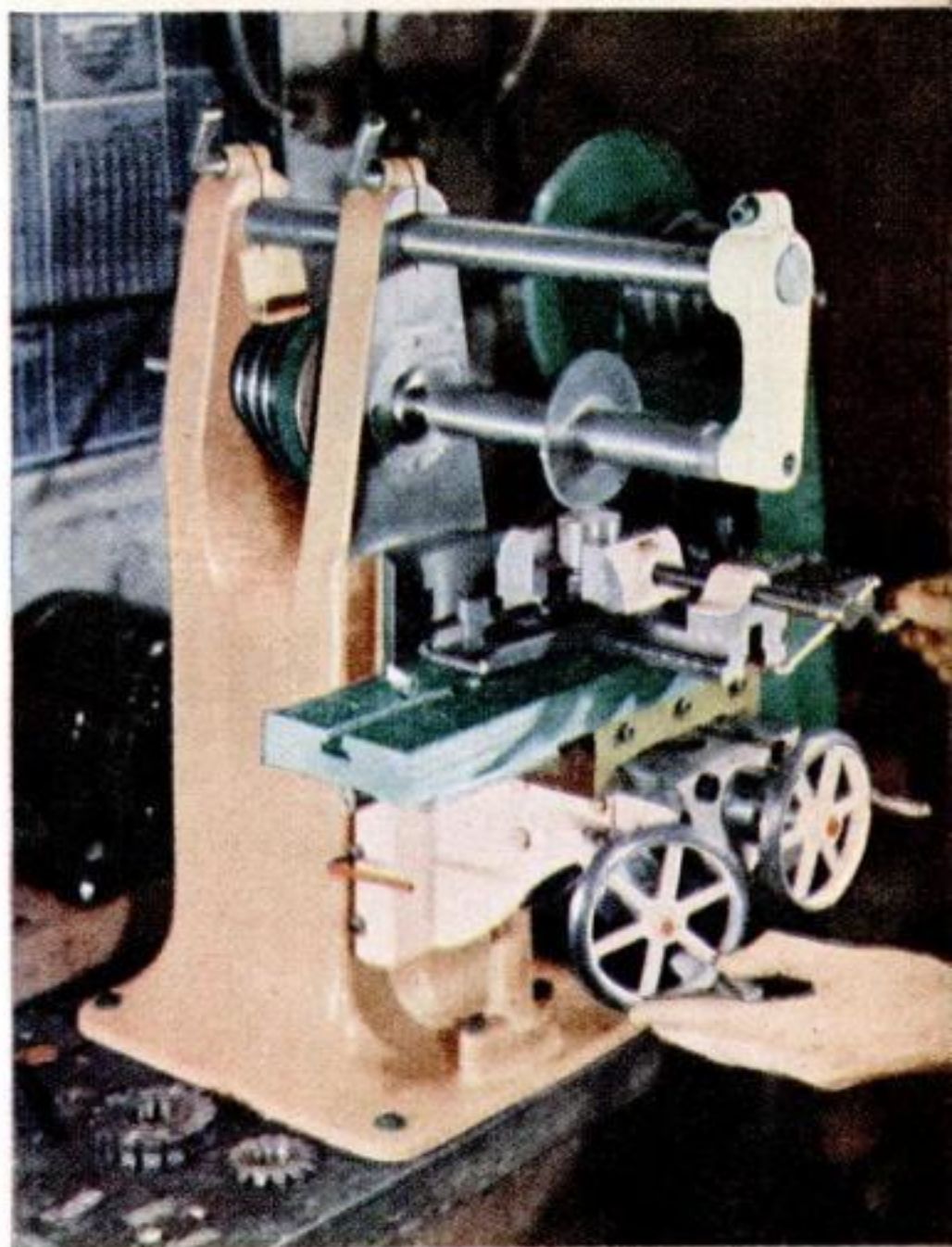
By Walter E. Burton

CAN a craftsman of average ability build himself a milling machine? And if he does, can he expect that it will turn out precision work?

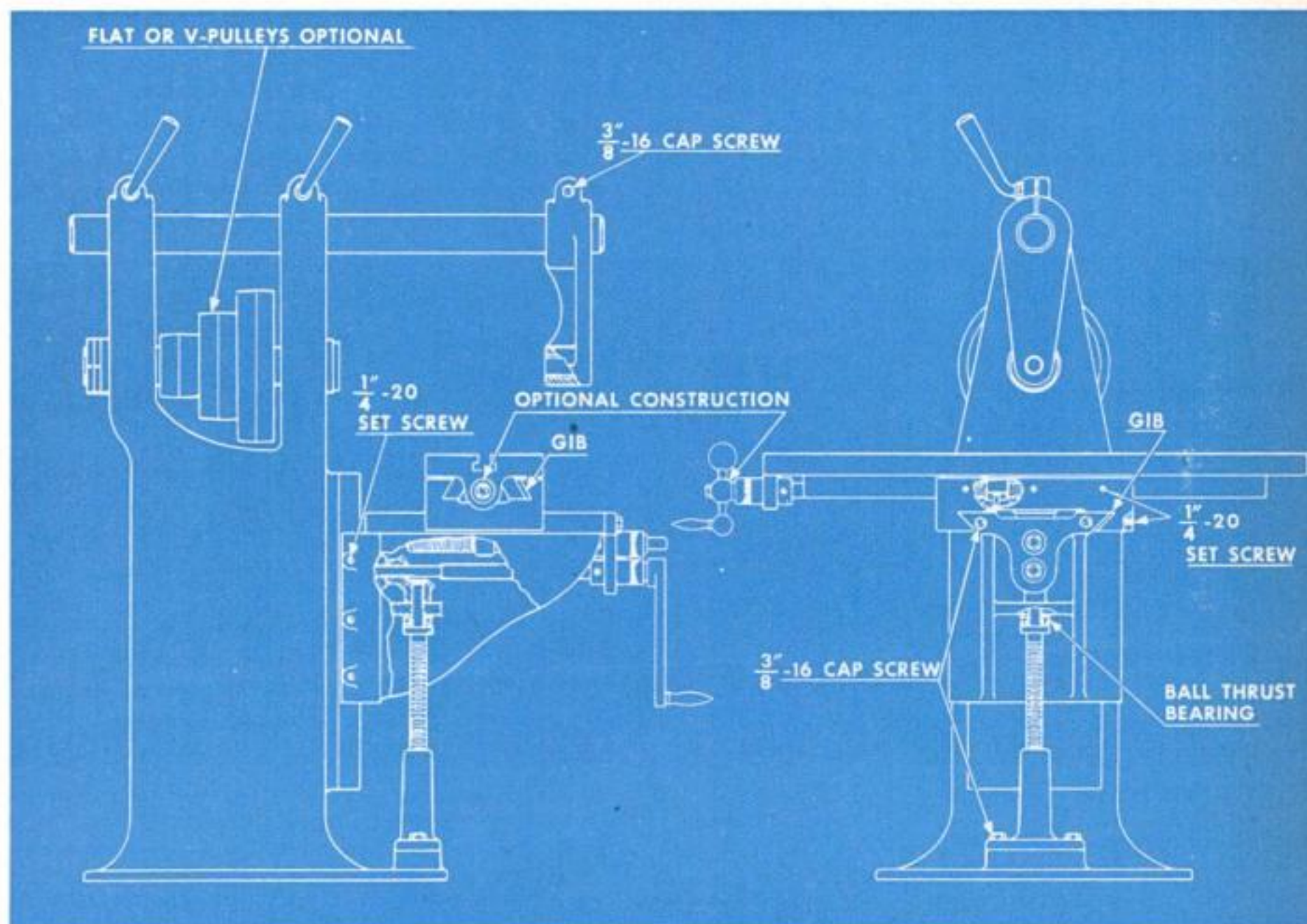
You bet!

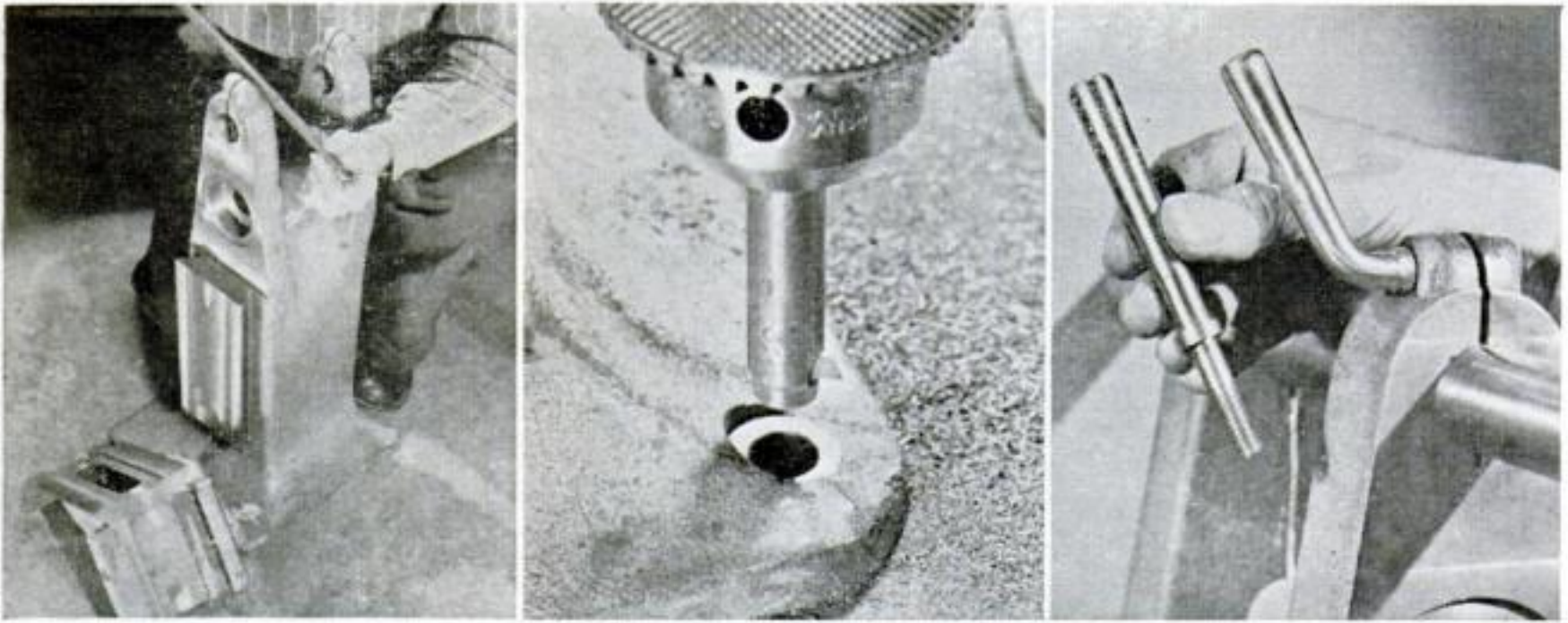
In my shop there's a little bench mill that proves both points, at least to my own satisfaction. It also demonstrates that if you start as I did with semifinished castings, the entire job can be handled with just a 9" lathe and drill press.

Of course I could have made up a set of patterns, had them cast at a foundry, and



This is it—the finished mill at work. Below, an assembly blueprint furnished with castings.





File all rough spots from the semimachined castings before starting assembly, and fill blow holes with either auto-body solder or suitable iron cement. Drill each corner of the column base for a $\frac{3}{8}$ " or $\frac{1}{2}$ " bolt, spot-facing (center) as necessary to provide a flat area for the head.

Overarm clamp screws are made by turning a handle to the shape shown above, cutting a $\frac{3}{8}$ "-16 thread on the end, and then bending the handle until it makes an angle of about 110 deg. with the threaded part. Drill and tap the slotted projections for these.

begun from scratch. Apart from the extra labor this would have taken, I'd have needed a shaper, planer, or large milling machine to make the flats, dovetails, and T-slots that are already accurately formed on semifinished castings. As it was, there was plenty of nice, finicky machine work.

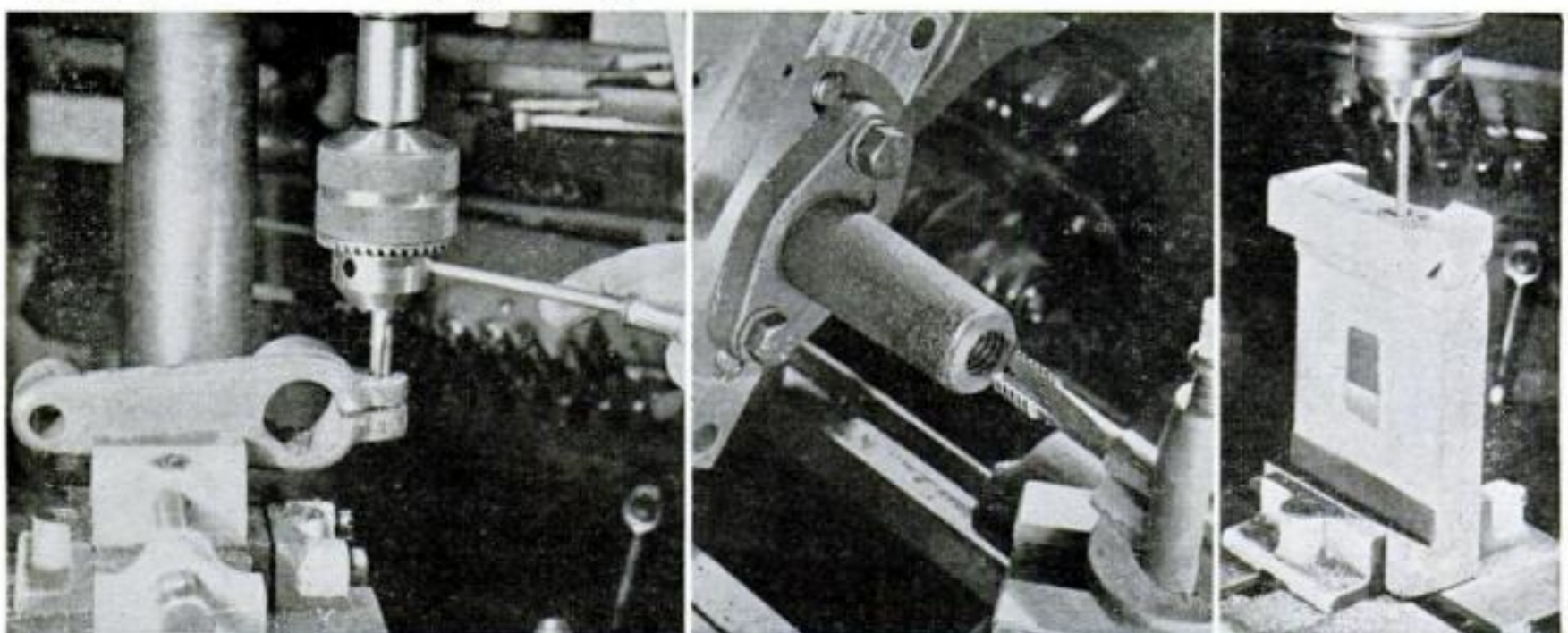
When you make your own machine tools, you always have the privilege of modifying the design and trotting out what ingenuity you have. This bench mill, I found, was no exception. Though the maker* supplied good prints, I departed from them in numerous small ways: micrometer dials were made extra large, permanent handwheels

replaced the crank, and the table-elevating control sprouted out in an entirely new and (I think) better place.

Let's assume you've ordered a set of semi-finished castings and the necessary steel bar stock, bronze nut blanks, and bearings. The first step on the main casting is to file down all rough edges and fill any blow holes with solder or iron cement. Drill and spot-face mounting holes in the base, and drill and tap the slotted projections at the top that lock the overarm. Don't forget to open out the left sides of these holes screw-clearance size to get clamping action.

The overarm bracket that forms the out-

*The Lewis Machine Tool Company, Los Angeles.



Bore a $1\frac{5}{16}$ " hole in the larger end of the arbor-support casting, slot it, and provide a $\frac{3}{8}$ "-16 locking bolt. Thread the lock-screw hole as above, turning the tap by inserting a rod or Phillips screwdriver in the chuck. In the smaller end, bore an oversize hole, press in a bronze

bushing, and ream to $\frac{3}{8}$ ". Acme threads for the elevating screw are roughed out with a single-point tool and finished with a homemade tap (center) cut with the same gear setup. Drill and tap holes in the saddle casting for the gib screws, as at the right.

board arbor support is bored out, slotted, and tapped for a clamping capscrew. (A long locking screw might be a hazard here.) The hole for the arbor bearing should be located carefully; it must have a center-to-center distance with the upper hole that corresponds precisely with the same holes on the main casting. Press in a bronze bushing, but don't ream it yet.

Three lathe-turned screws are required to control table movement, the longitudinal and elevating screws having right-hand threads, and the transverse feed screw being left-hand. They should preferably have standard Acme threads, although V-threads will do. Cut them carefully on the lathe, using a follower rest. While the nuts that fit on these screws may be threaded with single-point tools in the lathe, it is better to make the finish cuts with taps. I made three special taps of cold-rolled steel while the lathe was set up for cutting the screws, case-hardening the cutting edges.

After the two bronze feed nuts have been threaded, drill and tap each for 10-24 mounting bolts and face off their bases. If you use handwheels rather than the crank, the distance between the cross-feed screw and the bottom of the saddle can be greater than the blueprint indicates.

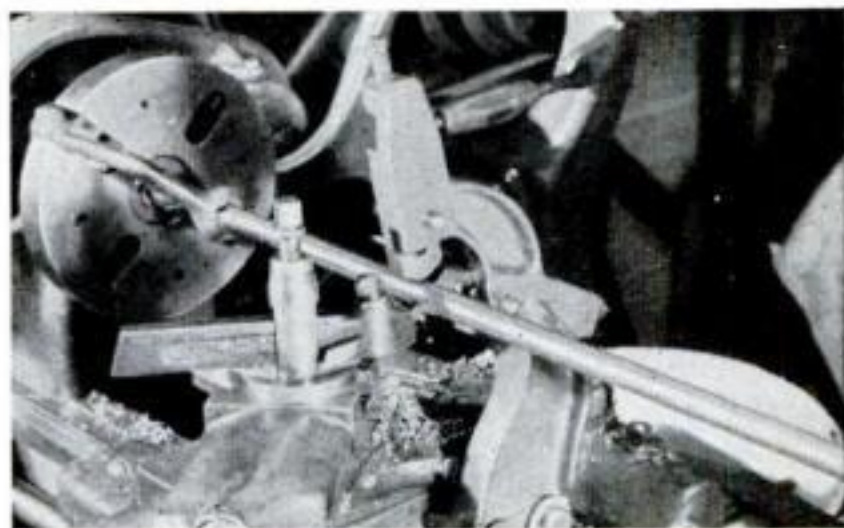
Drill an $11/16$ " or $3/4$ " hole in the projection at one end of the table casting for the longitudinal screw. Install a flanged bronze bushing and ream it for the $1/2$ " screw shank. The thrust in one direction is between the bushing flange and the micrometer collar; in the other direction it is between the inner end of the bushing and a small collar mounted on the screw. You can install the table with the crank at either side.

The vertical-feed screw operates in the threaded post bolted to the base of the main casting. Its upper end extends through a web that forms a part of the knee casting. Drill and ream the web to receive the $3/8$ " portion of the vertical screw, spot-facing both ends of the hole. The weight of the knee is borne by a ball thrust bearing between the web and the elevating-screw shoulder. On the upper end of the screw one of a pair of steel miter gears is secured by means of a taper pin.

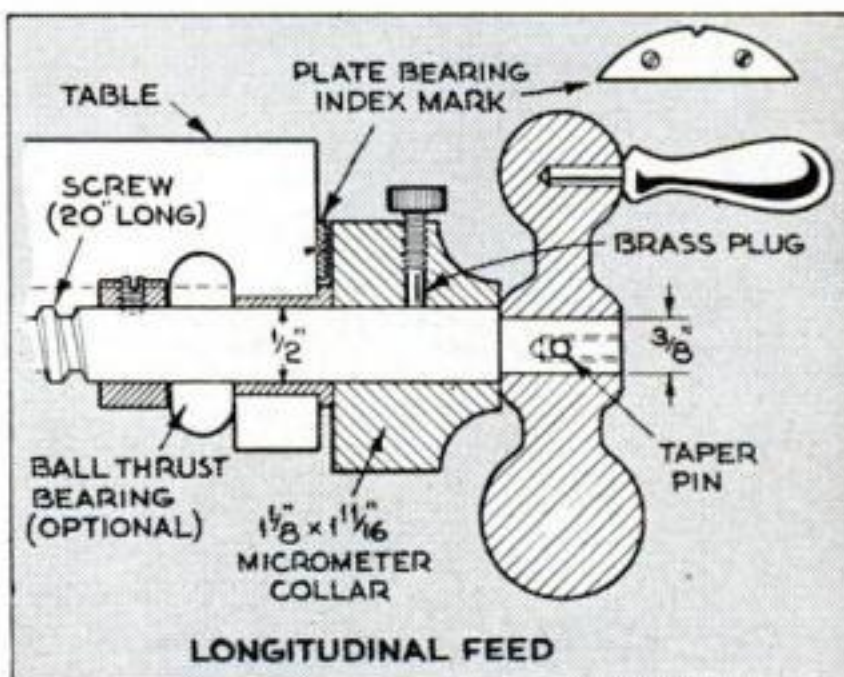
Alternately, the bearing might be arranged in the knee web by drilling an oversize hole and mounting under it a $3/16$ " by 1" by 1" brass plate with a reamed $3/8$ " hole and four $1/4$ " corner holes for 8-32 mounting bolts. The oversize mounting-



Gibs are cut to length from steel strips and their edges are beveled to match the dovetail angles. After placing the gibs in position, spot-drill each to receive the screw points.

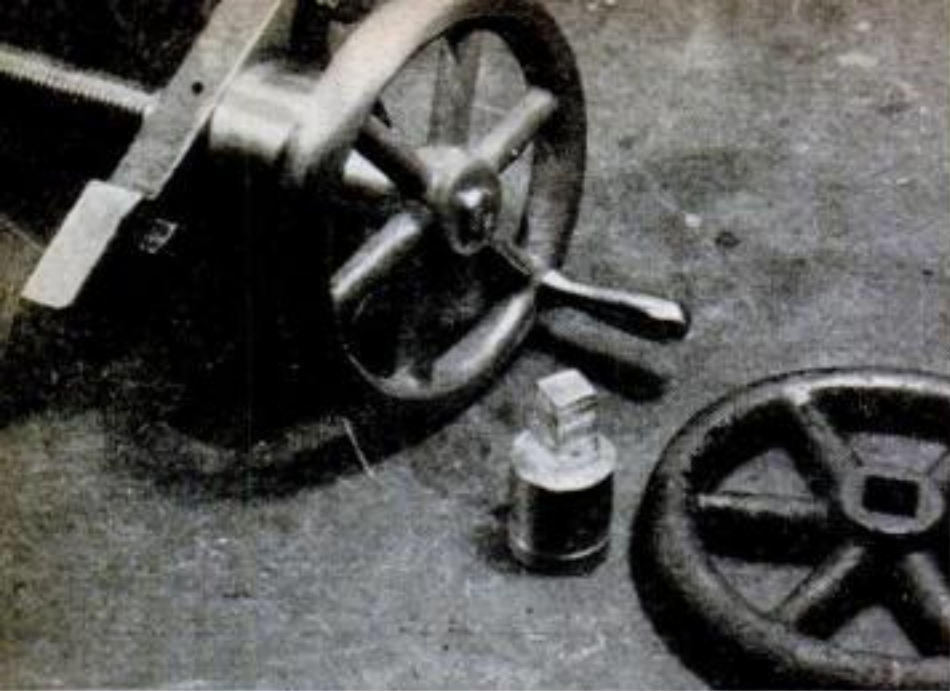


Use a follower rest in cutting threads on the longitudinal feed screw. Standard V-threads will serve for this and the other two table-control screws, but Acme threads are better.

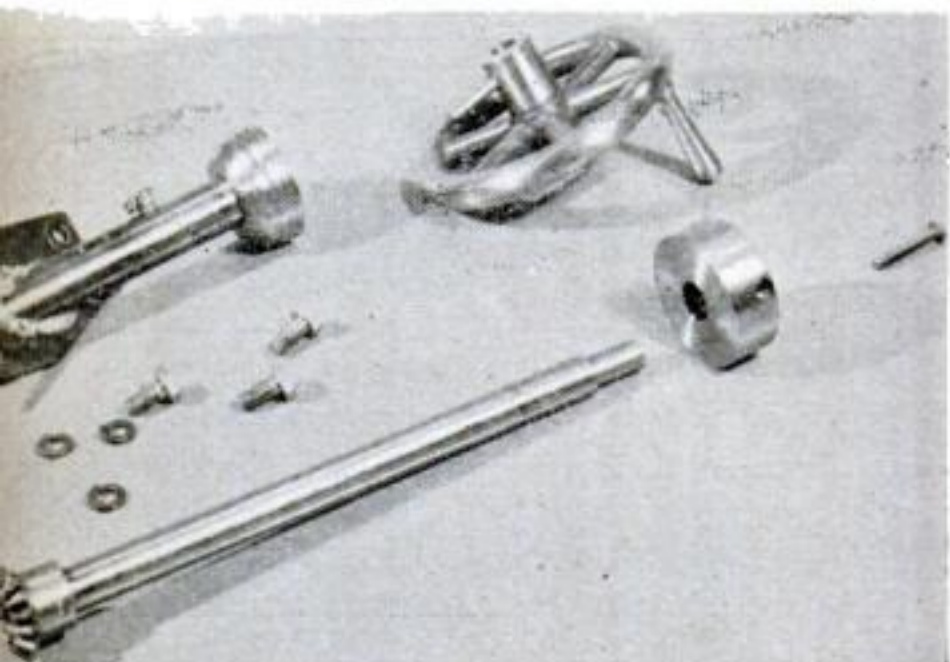
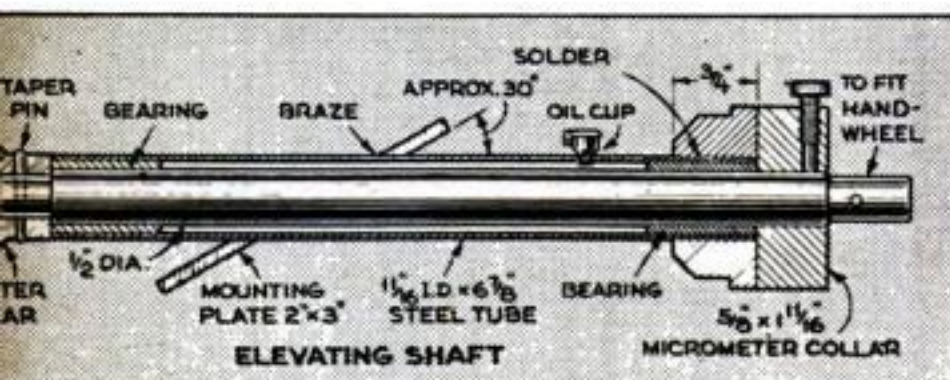
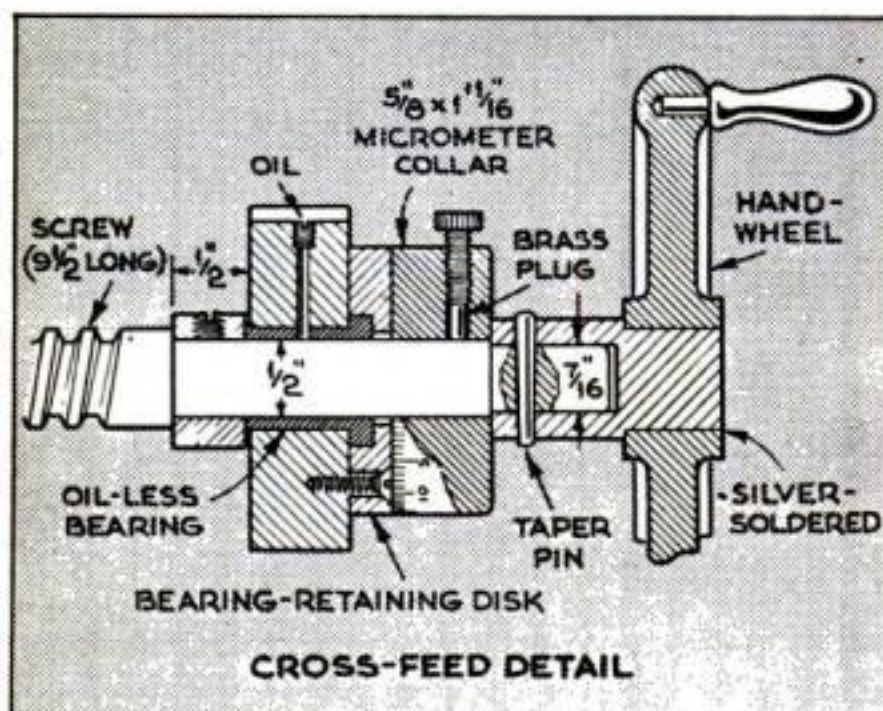


screw holes would permit the plate to be shifted to obtain perfect alignment of hole and elevating screw. Then the plate bolts could be tightened.

The second miter gear is mounted on a $1/2$ " shaft that extends outward at an angle of about 30 deg. through a $3/8$ " diagonal hole in the side of the knee casting. This elevating shaft rotates in two bronze bushings in the ends of a $6 3/8$ " length of $11/16$ " i.d. tubing. Solder a steel collar with an index



The cross-feed screw is supported at its outer end by a casting attached to the knee dovetail with two $\frac{3}{8}$ " bolts. A handwheel was machined from a 4" valve wheel like the one at right.



Three $\frac{5}{16}$ " bolts attach the elevating-shaft mounting plate to the side of the knee casting, a $\frac{3}{8}$ " diagonal hole being bored through the casting itself for the tubular housing.

mark to the outer end of the tubing.

A ball crank is installed on the longitudinal feed screw. If the elevating shaft is brought out at an angle, permanent handwheels can be used on the vertical and horizontal controls. These might be cast at home, using a lathe tailstock wheel as a pattern, or made from 4" cast-iron valve handles.

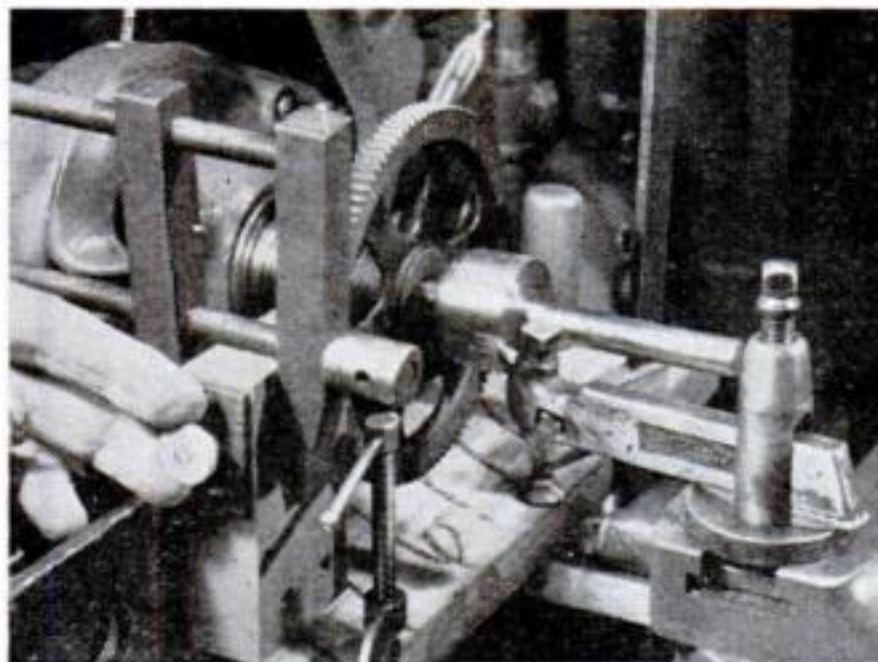
For the micrometer collars cut disks from a cold-rolled or stainless-steel rod, drill a center hole, and ream it to $\frac{1}{2}$ ". About $\frac{1}{4}$ " from one end of each blank, tap a hole for a $\frac{1}{4}$ " setscrew. With this screw, lock each blank in turn on a true-running mandrel and machine it to a diameter of approximately $1 \frac{11}{16}$ " and a suitable length.

Each collar has 100 divisions, every tenth one being numbered. These graduations may be cut by locking the collar with a setscrew on an arbor in the lathe chuck or collet. If your lathe doesn't have provision for indexing, mount a 100-tooth gear wheel between the collar and headstock. Devise a plunger to fit between the gear teeth so it will hold rigidly yet can be backed out as needed.

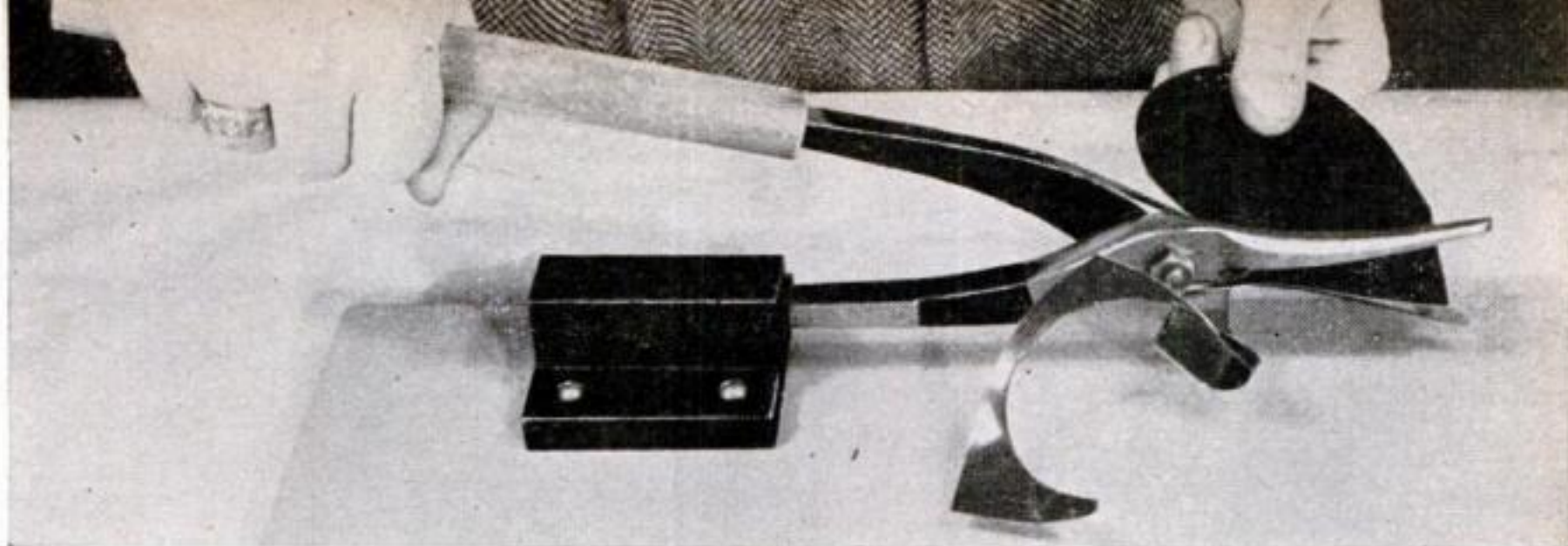
Mount a tool bit ground to a slightly flattened point, and lock the compound rest parallel to the lathe bed. Set the tool to plow a neat furrow in the collar blank when moved toward the headstock.

Although the micrometer scale on the compound rest may be used to control the lengths of the lines, an easy way is to use pieces of steel rod as stops to limit carriage movement. After the lines are cut, remove the collar from the mandrel and stamp the numerals.

TO BE CONTINUED



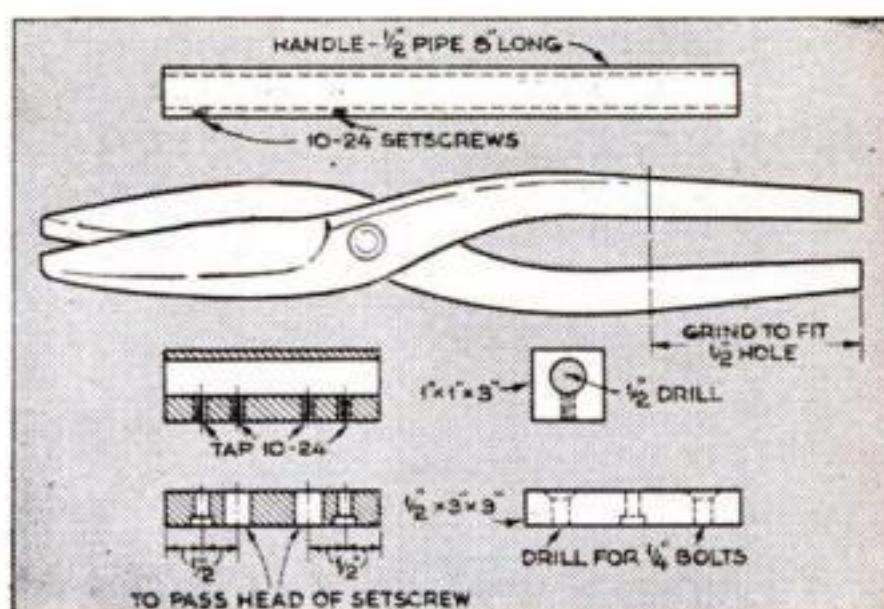
Micrometer collars were graduated with this setup, a 100-tooth gear wheel serving as an indexing guide. Oversize collars are desirable in order to improve visibility of the scales.



While one hand exerts pressure downward, the other hand can guide the cut with accuracy..



Two steel blocks, a length of pipe, and a pair of good snips are the chief materials needed.



Tin Snips Converted to Bench Tool

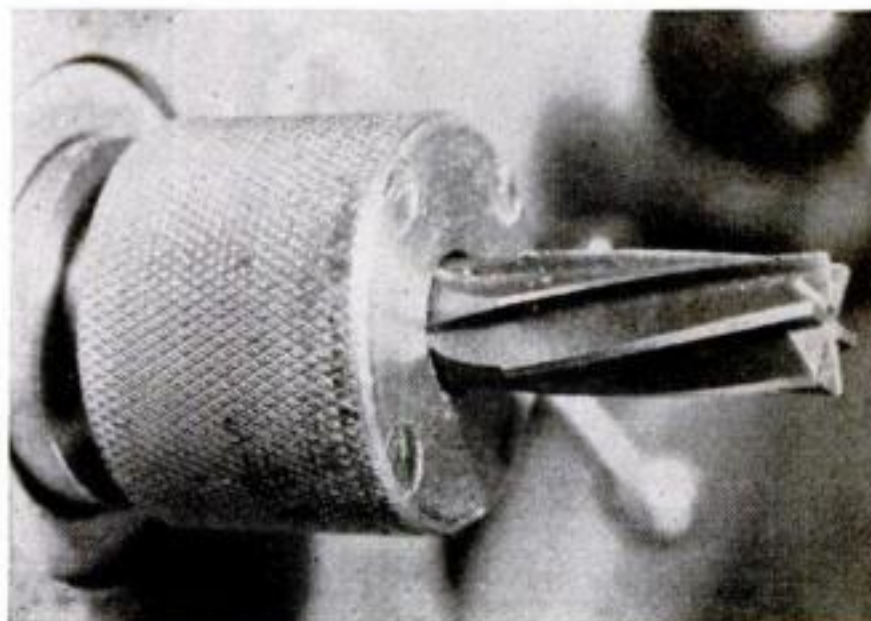
CUTTING sheet metal is a pleasure with these bench snips. Not only can you apply more pressure with less effort, but you can also guide the cut along layout lines with great accuracy. Obtain a good-sized, high-quality pair of tin snips and remove the handle loops (if they're hardened, save your hacksaw blades and use a grindstone or cut-off wheel). Work the ends down to fit a $\frac{1}{2}$ " hole. Drill a hole of this size through a 1" by 1" by 3" block, locating it a bit off center, and tap the four setscrew holes shown. Drill

four matching holes in a base block, making the two inner holes large enough to clear the setscrews and counterboring the outer holes. Also drill and countersink holes in the base for mounting bolts.

Assemble the blocks with setscrews in the two outer holes, and secure one handle of the snips in the $\frac{1}{2}$ " hole with setscrews through the inner holes. A piece of $\frac{1}{2}$ " pipe is driven on the other handle to provide a grip and furnish enough leverage for easy cutting.—Jack Mellinger, West Orange, N. J.

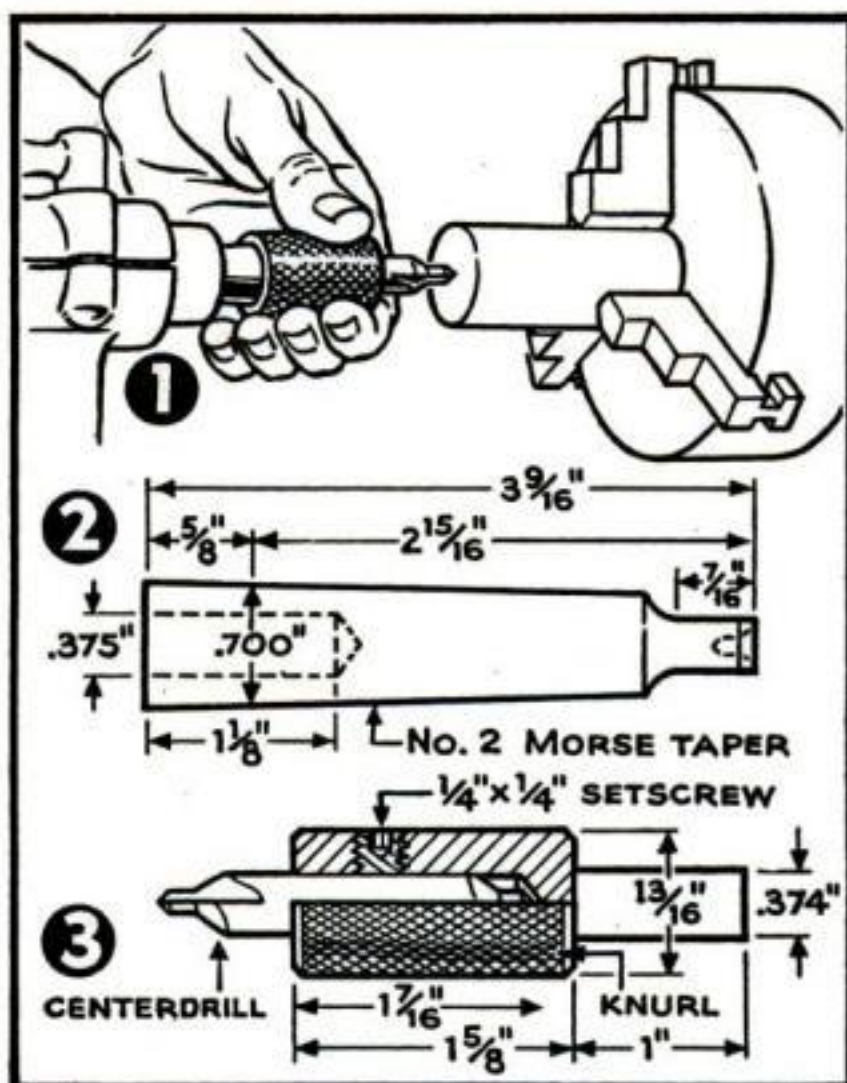
Nut with Collar Retains End Mill in Headstock

END mills with tapered shanks won't work loose in a lathe headstock spindle, even with side thrust, if they are locked on with this collarlike nut. One end of a nut threaded to fit the spindle is covered with a plate about $\frac{1}{8}$ " thick held on with machine screws. The piece is then turned, faced, knurled, and drilled the size of the largest end mill to be used. When you use smaller end mills that might work through the drilled hole, place a washer over the small mill and then assemble it and the locking collar.—H. L. Phillips, Watertown, Mass.





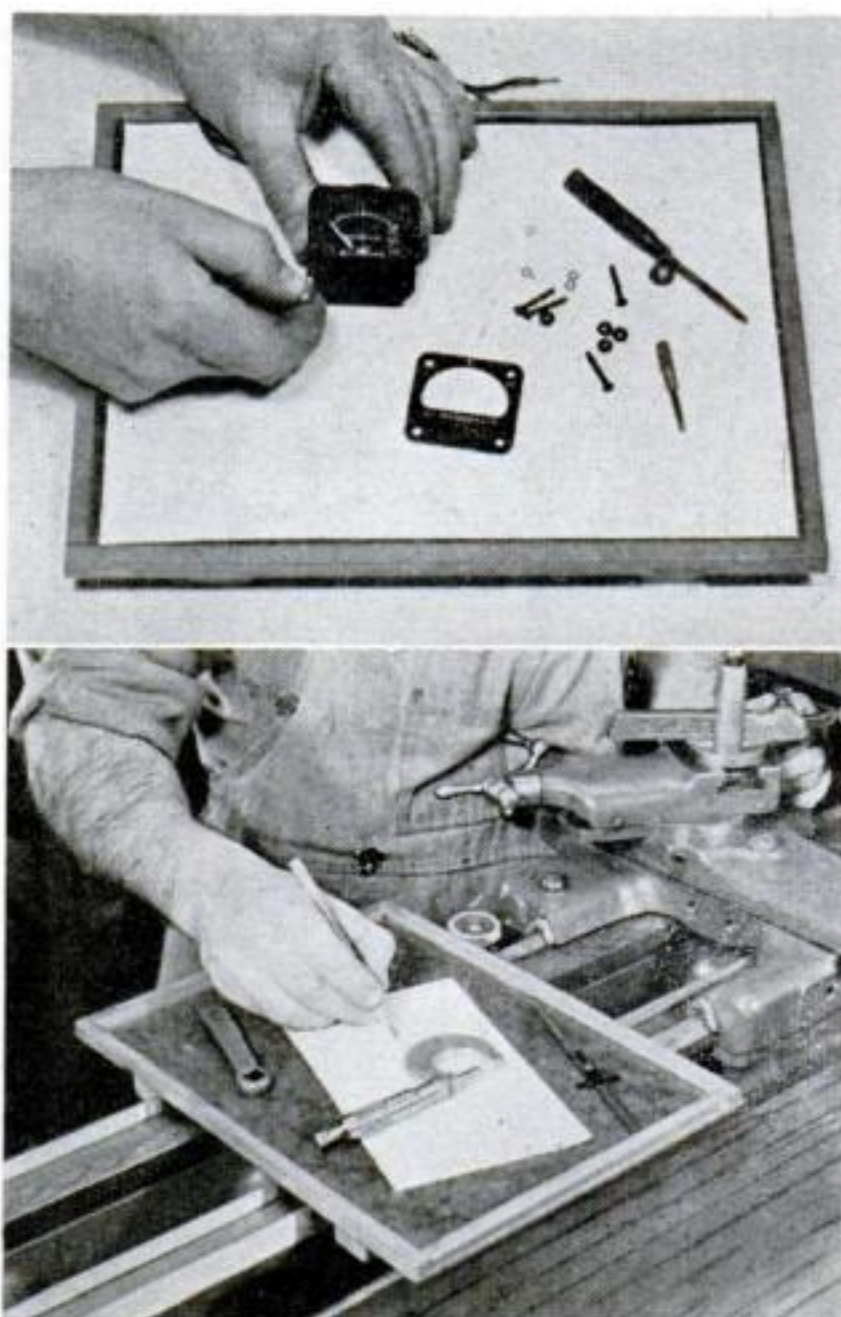
NEW SHOP IDEAS



Centerdrill Holder. This releasing centerdrill holder, used as in Fig. 1, will cut down drill breakage, because when the going gets tough, the adapter unit will turn in your fingers. It will also serve as a holder for small taps and twist drills.

Turn the taper shank (Fig. 2) on centers, using either the setover-tailstock method or a taper attachment. If you use the former method, leave the smaller end of the taper about .060" oversize on the first cut to permit correcting the amount of setover if necessary. When the piece has no shake in a No. 2 Morse taper socket, it can be brought down to within a few thousandths of finished size by measuring the small end, which is .556" finished. Final fitting is done by filing, polishing, and testing with marking blue. Bore the hole by putting the shank in the headstock with a .375" drill in the (recentered) tailstock. Mill or grind the tang to shape.

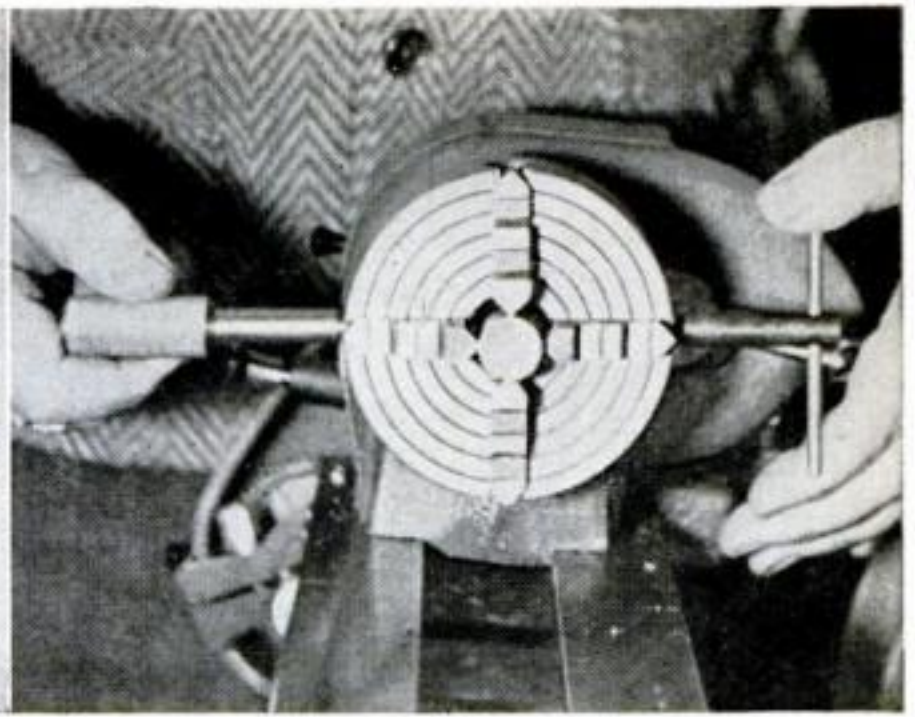
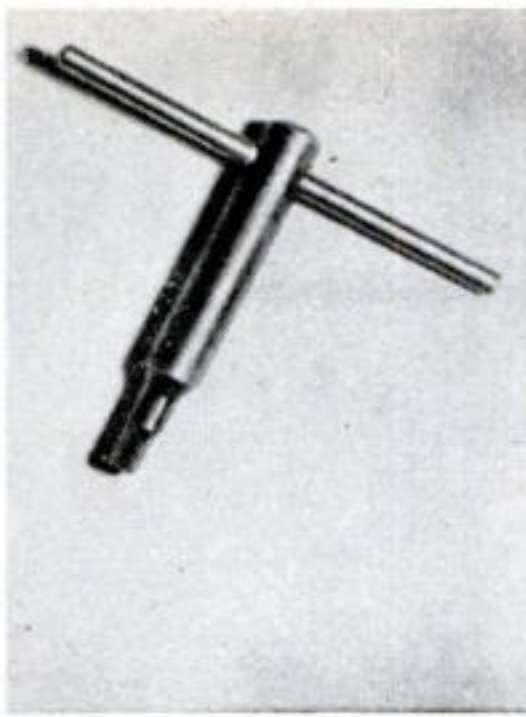
The adapter, Fig. 3, can be machined in one chucking with tailstock support at the outboard end. Knurl the work before turning accurate dimensions. The centerdrill hole can be drilled by mounting the tool as for use, with a drill held in the headstock.



Tray for Tools or Parts. Simple trays of the kind shown above have proved time and temper savers for a small shop specializing in instrument work. Each one consists of a piece of hard composition board about 3/8" by 8" by 12", with 3/8" square strips nailed around to form a lip. The underside is cleated to fit the lathe ways.

On the lathe, the tray is convenient for the micrometer, wrenches, drills, and tool-bits that would otherwise mix with the chips on the lathe bench. Used on a workbench, the tray is fine for holding tiny nuts, washers, and other parts. A clean sheet of paper on the tray aids visibility.—D. J. Bachner, Jackson Heights, N. Y.

Improving Aluminum Castings. While old auto pistons and other aluminum alloys are a valuable source of metal for home castings, trouble is frequently encountered with blow holes, pin holes, or spongy places. A good dodge to eliminate this trouble is to toss in several pieces of sal ammoniac crystals when the metal is ready for pouring; this will bring the dross to the top so it can be skimmed off before pouring.—A. E. Kerswell, San Bernardino, Calif.

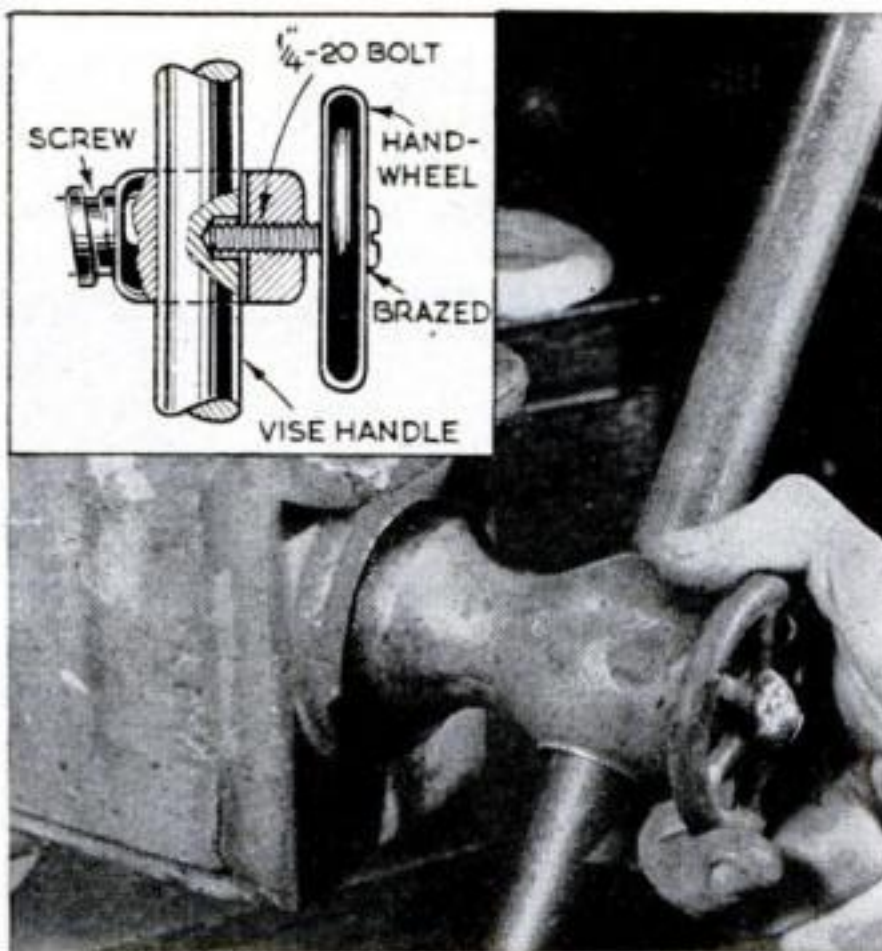


Speed Wrench for Four-Jaw.

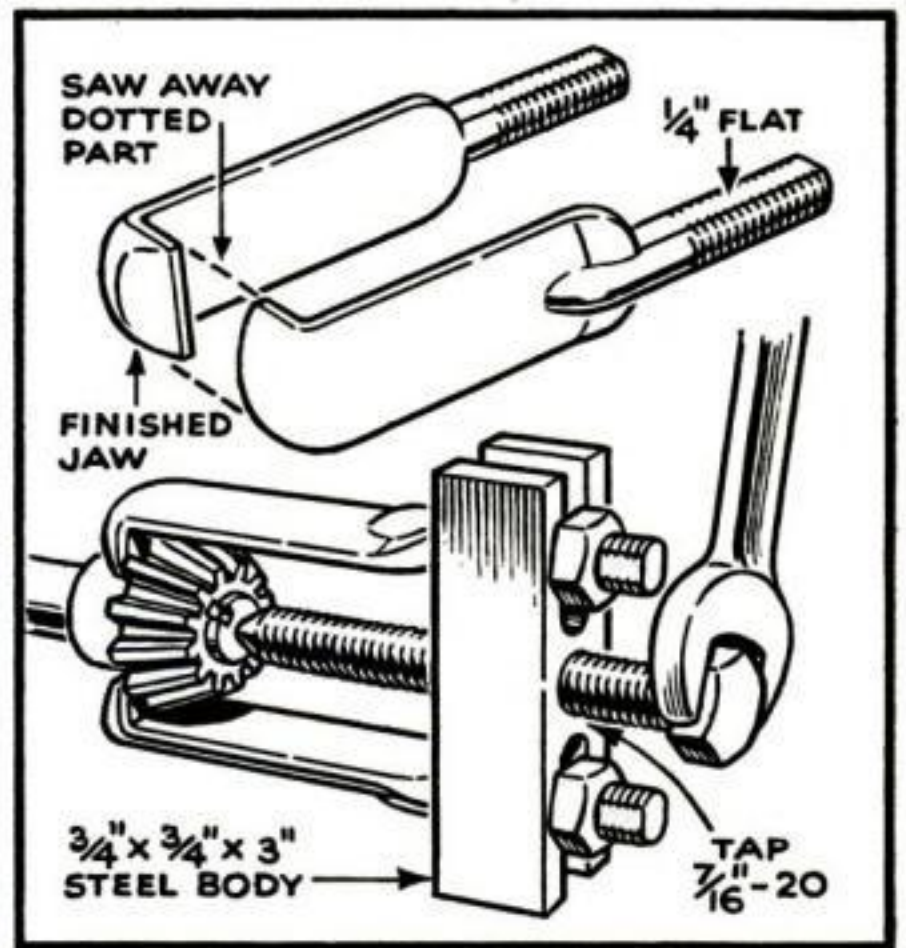
Much of the drudgery of setting up work in a four-jaw chuck is eliminated with a "screwdriver-type" chuck wrench. It will greatly speed up reversing the jaws. Used with the regular wrench in centering work, it eliminates constant switching of a wrench from socket to socket. Its spinner grip gives

a sensitive "feel" ideal for chucking delicate pieces that are easily distorted.

Proportion it to suit the chuck you chiefly use; mine was turned of $\frac{3}{4}$ " stock for a 4" chuck. While the square shank can be milled, careful freehand grinding finished by filing will do the job nicely.—*John M. Avery, Delhi, N. Y.*



Wheel Locks Vise Handle. After the heavy handle on a large vise had dropped through its eye to pinch a mechanic's hand, he devised the simple locking rig shown above. A hole was drilled through the end of the eye and tapped $\frac{1}{4}$ "-20. In this he turned a bolt that had been brazed to a small valve handwheel. The bolt bears in a dimple drilled in the middle of the handle. Locked centrally in this way, the handle gives plenty of leverage for most needs, but it can be readily loosened and slid out if more force is needed.



Puller from Spring Clip. First sawed and then ground to final shape from an automobile spring clip, this little puller is convenient for removing gears, ball races, collars, and pulleys. The flats on the threaded ends not only prevent rotation in the slots of the bar but also make the puller adjustable for size, which is a useful feature. The cap screw is about $2\frac{1}{4}$ " long, is threaded full length, and has a 60-deg. rounded point. Parts subject to wear such as the screw point and sidepiece jaws should be case-hardened.



AIDS TO MODERN LIVING



Keep Score on Putter. With a golf putter made by P. M. Connelly, of Oak Park, Ill., you don't have to fumble for score card and pencil after each hole. An 18-hole card slides into grooves on the back of the putter and a pencil clips to it.



Trigger Releases Wax. A floor waxer manufactured by New Products, Inc., of St. Louis, Mo., has a container that holds a pint of liquid wax. Pushing a trigger at the top of the 47" handle releases wax through the removable felt applicator.



Strolling in a High Chair. Now you can have a high chair and stroller for the baby—both combined in one piece of space-saving equipment. Invented by C. B. Johnson, the chair-stroller above was shown at an inventors' exposition in Los Angeles.



Drum Glows in the Dark. Designed especially for use in a child's room or game room, this novelty lamp features a luminescent drum head that glows as a circle of light in the dark, making it easier to locate. Made entirely of plastic, it is a product of the Radio Frequency Laboratories, of Boonton, N. J.

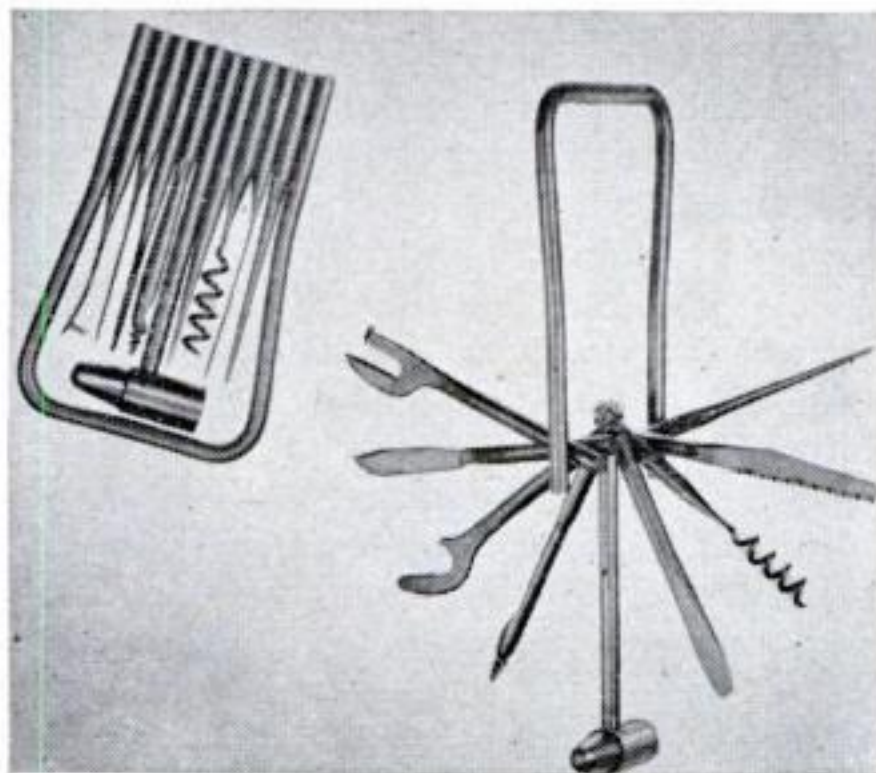


Tells the Tale.

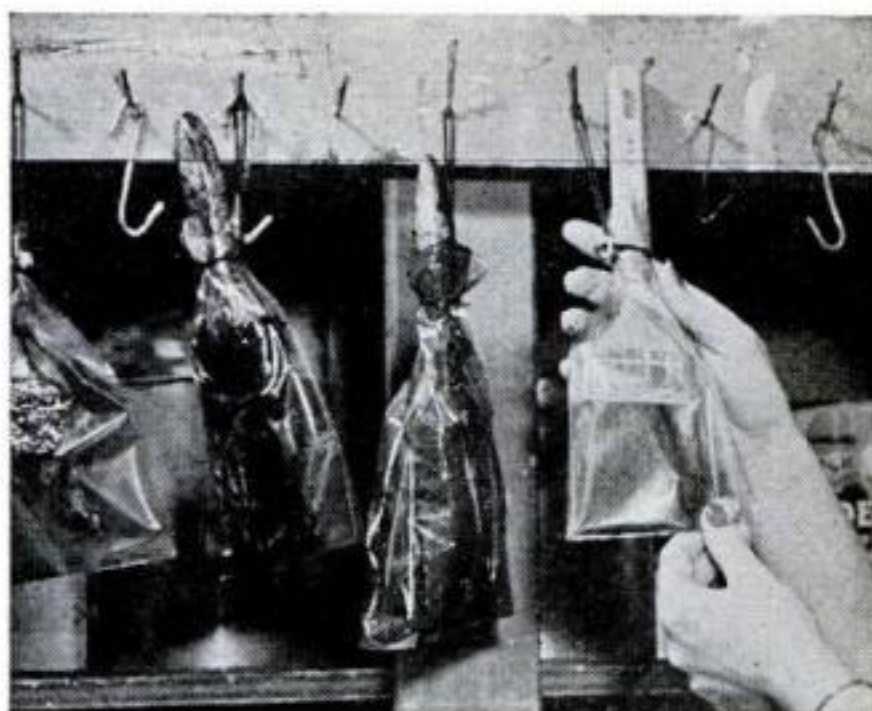
Here's a gadget that will put an end to those fish that increase in length and weight every time the story's told. Called the "De-Liar," the combination scale and measuring tape will weigh up to 2 lb. and measure up to 24". Small enough to carry in the pocket or pack with your equipment, it is available from Dexter & Co., of New York, for \$2.

You Squeeze It.

Bottles that you can squeeze are among the latest things to hit the market. But instead of glass, they're made of flexible plastic and won't break. The one shown here was molded by Plax Corporation, of Hartford, Conn., and it's used as a powder container, a hole in the stopper allowing the talcum to be blown out.

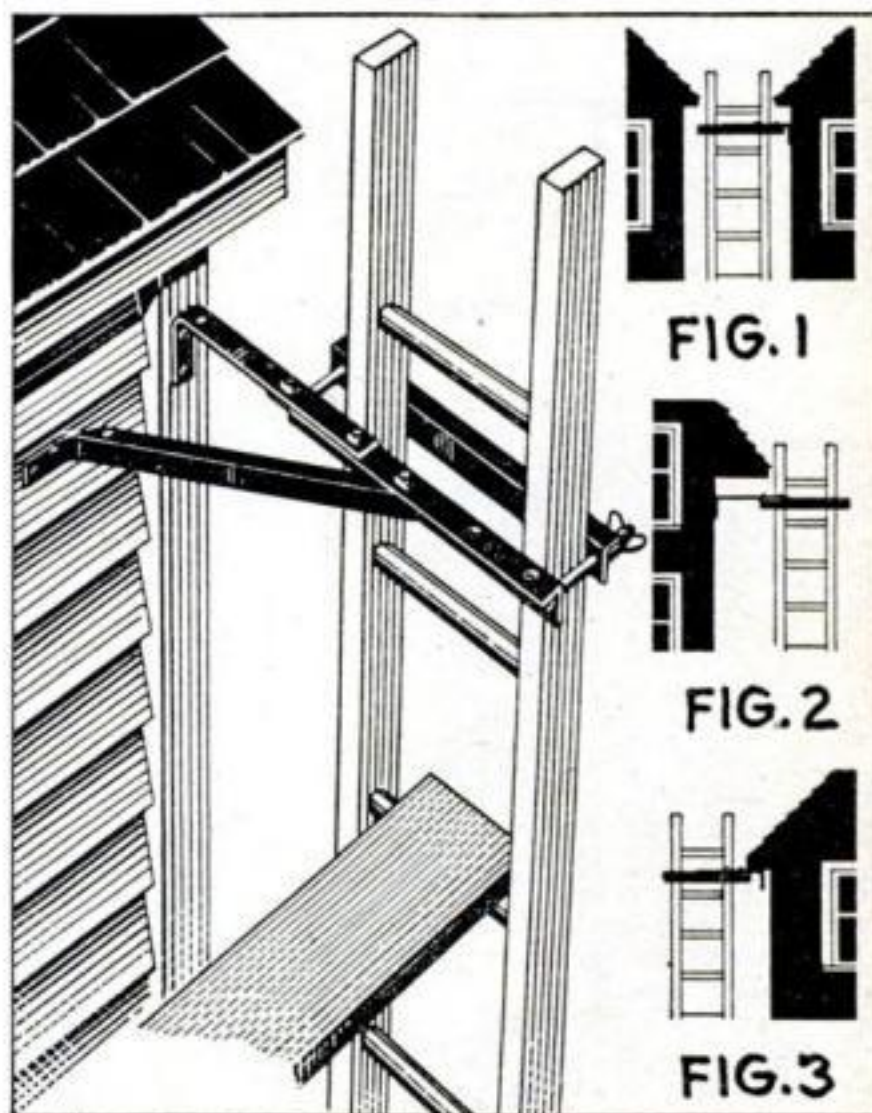


Tool Kit Fits Pocket. Here's a collection of handy small tools that you can carry in a pocket, all of them made of high-carbon cutlery steel. A product of Toolmaster, of New York, the kit includes a screwdriver, awl or ice pick, bottle opener, corkscrew, hammer or ice crusher, knife, can opener, auger, and saw.



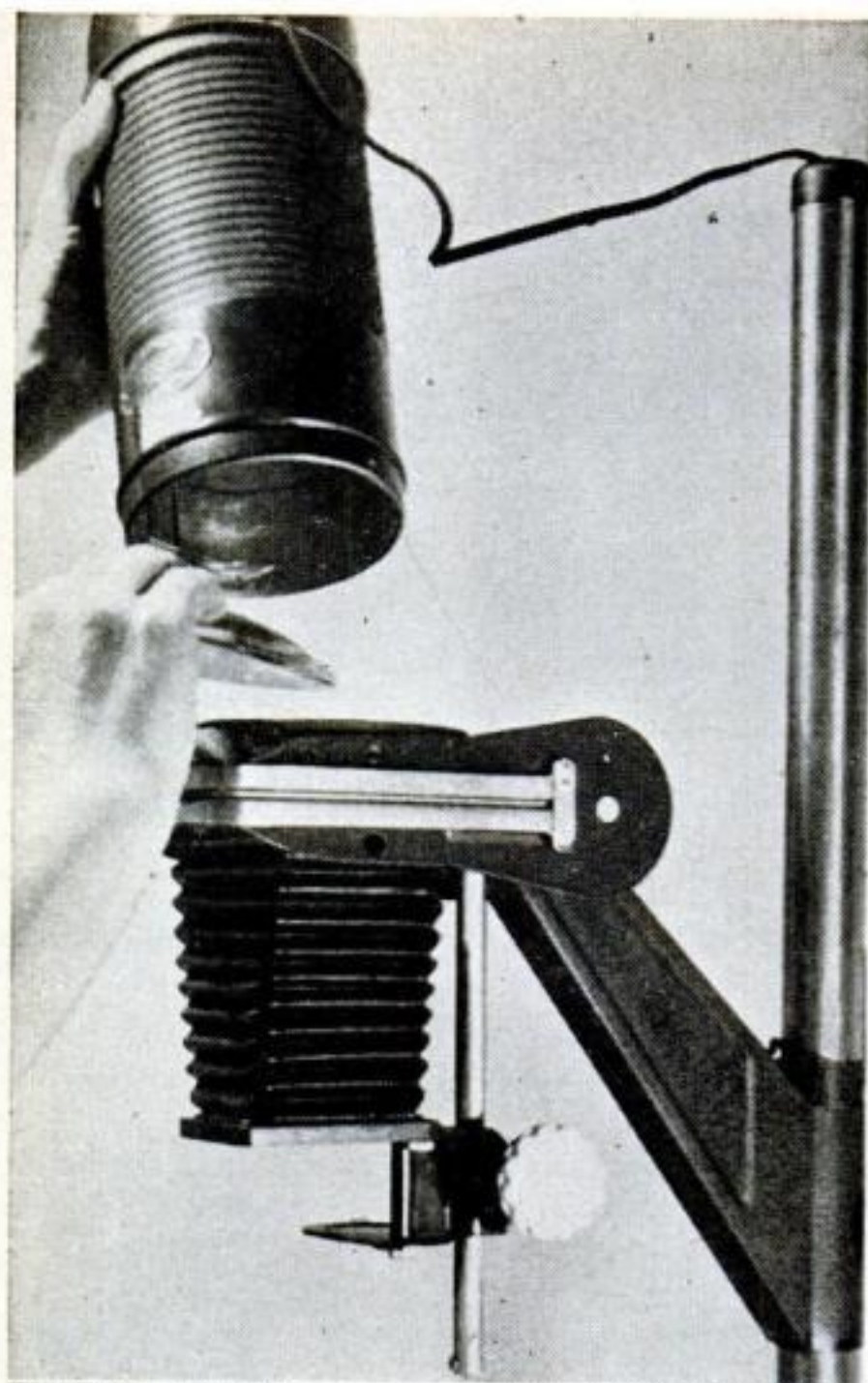
Brushes Needn't Be Cleaned.

If you're in a hurry, a used paint brush can now be put away without cleaning. Placed in a container made from the Goodyear Tire and Rubber Company's Pliofilm [®], the brush will remain soft and pliable until the next paint job comes along. The container has an elastic band to seal in the brush and to provide a loop for hanging it up so that the bristles won't spread.



Brackets Provide Scaffold.

Brackets that may be used with ladders to erect a scaffold are offered by Reimann and Georger, of Buffalo, N. Y. The brackets may be adjusted to keep the ladders close to the building in a narrow passageway (1), to clear the eaves (2), or they may be fastened under the eaves (3).



\$10 Condenser Conversion Better Enlarger

By Edward Morris

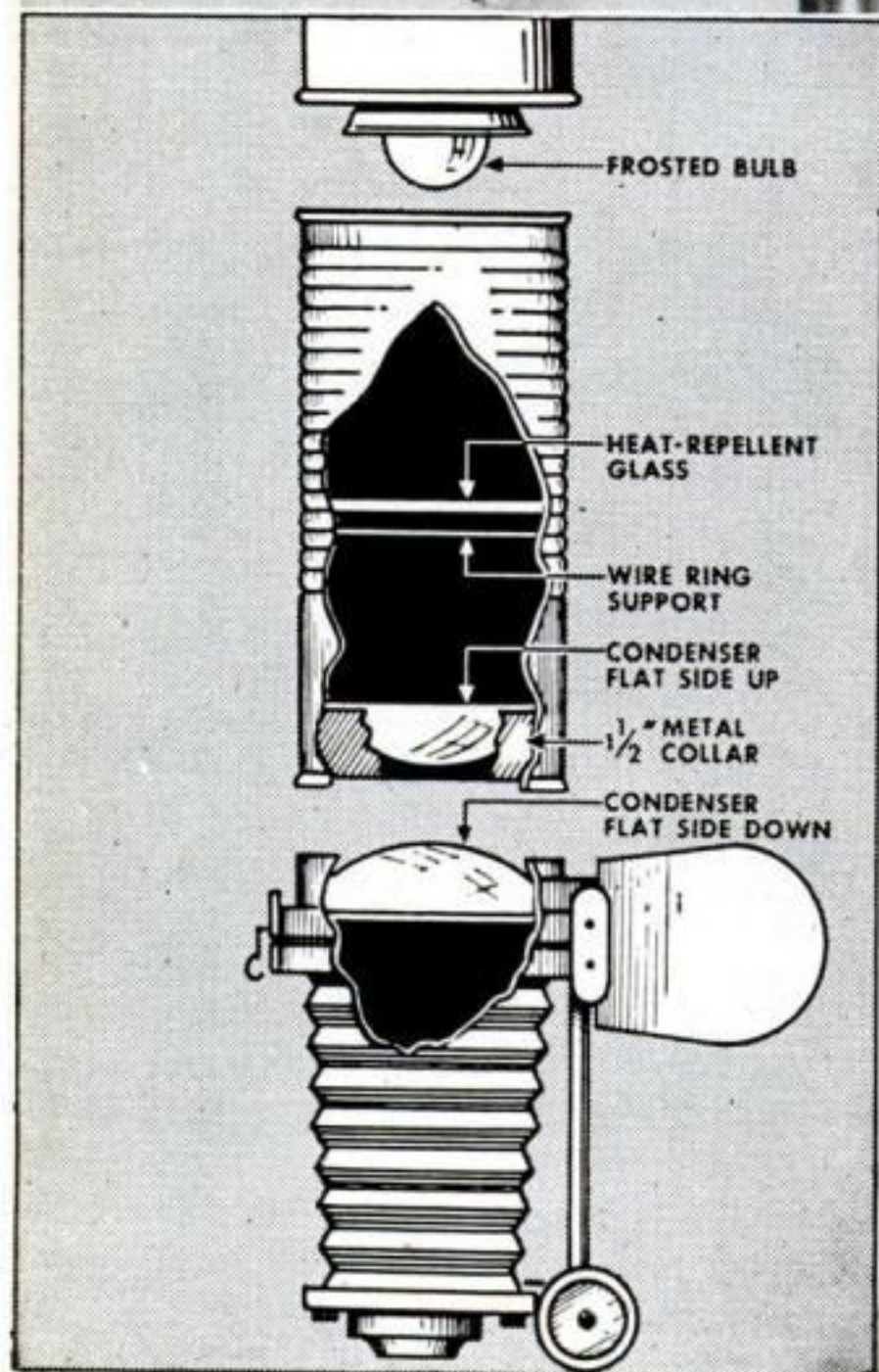
PERHAPS you've thought about converting your diffusion enlarger to a condenser type, and the experts tried to scare you off with lectures on optics, hot spots, and critical lens positions. They tried it on me. But I went ahead just the same and, instead of paying a goodly sum for a new condenser enlarger, accomplished a perfectly satisfactory conversion for about \$10.

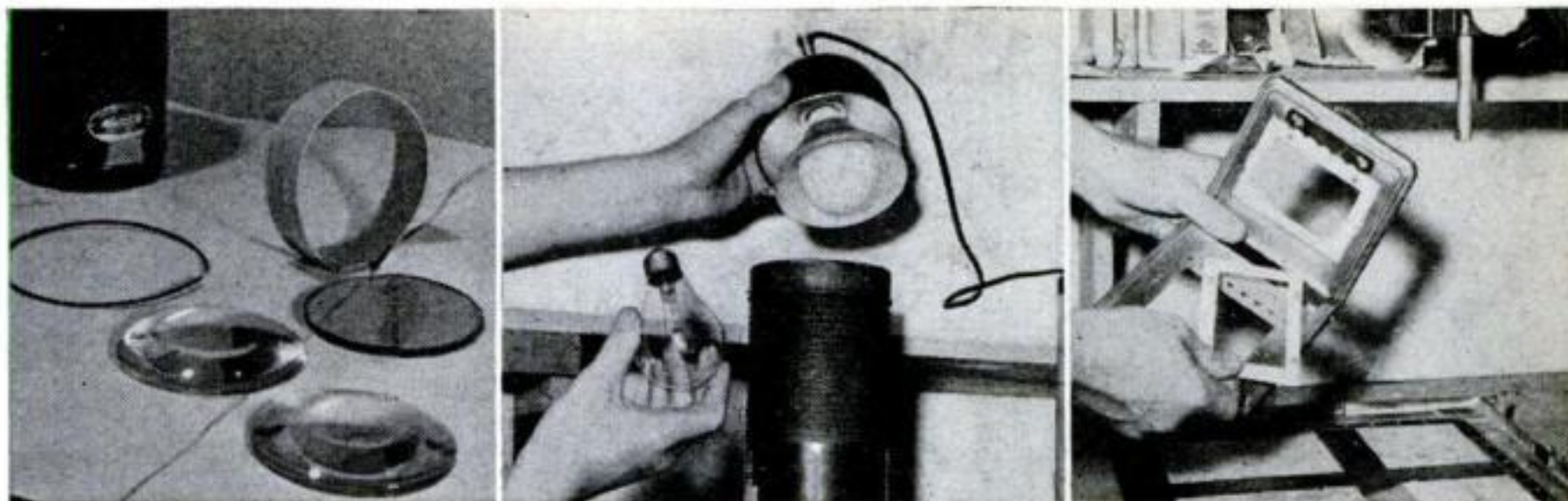
Two condenser lenses were picked up at a local photo supply house for \$7. These are $4\frac{7}{16}$ " in diameter, a size that's a snug fit in my particular enlarger. A $4\frac{7}{16}$ " disk of heat-absorbent glass, a strip of aluminum $1\frac{1}{32}$ " by $1\frac{1}{2}$ " by 15", and a 15" piece of No. 8 or 10 copper or galvanized wire complete the list of materials.

Heat-absorbent glass usually may be obtained at a window-glass or photo supply house. There are several makes on the market, but for this purpose get the closest you can to one having a formula of 72-percent transmission of ultraviolet light and 28-percent absorption of infrared. Incidentally, it may be best to let the supply house cut the disk of glass, for it's a difficult job. I broke two pieces trying to do my own cutting.

With the materials at hand, the actual conversion takes only a few minutes. First, remove the diffusion glass from the lamp house. Then position one condenser lens so that it lies above the negative carrier with the flat side down. Next bend the aluminum strip around a $4\frac{1}{2}$ " form, insert it in the very bottom of the lamp-house tube, and drop in the second condenser from the top, flat side up, so that it rests on the aluminum collar. Return the lamp house to position, making certain the condensers are close together but do not actually touch.

Now bend the wire around a $4\frac{1}{2}$ " form, squeeze together, and snap it into place in the lamp house midway between the bot-





Materials required were two condenser lenses, an aluminum collar, a disk of heat-absorbent glass, and a wire retaining ring. A frosted bulb

was also substituted for the clear one. A dustless carrier, right, eliminates the bother of keeping glass plates clean.

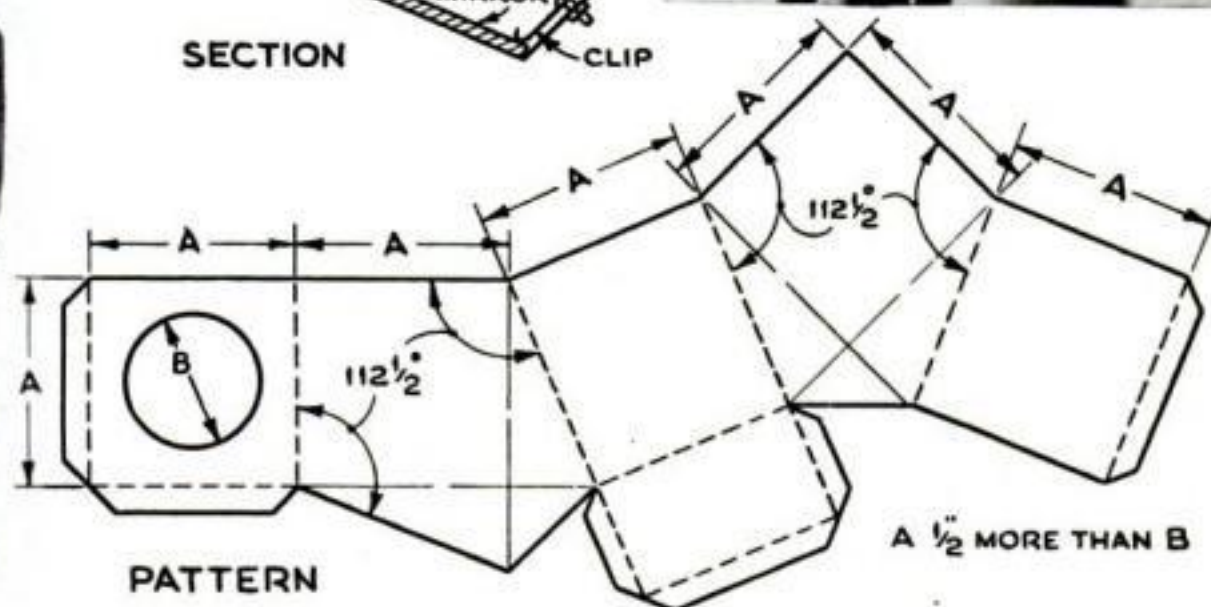
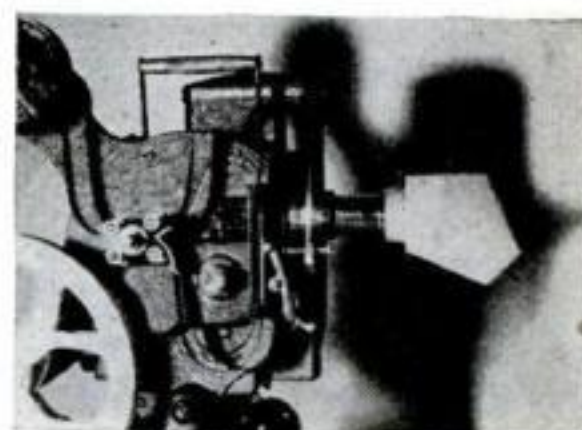
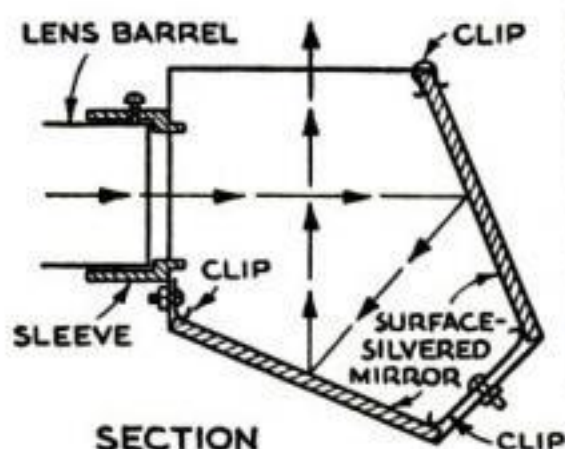
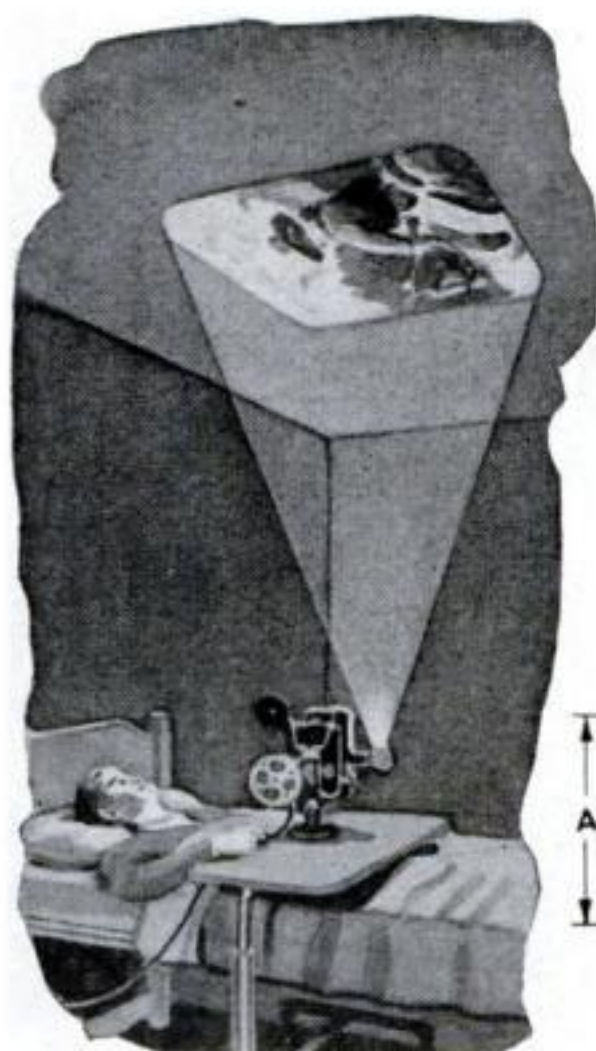
tom of the enlarging bulb and the top condenser. Place the heat-absorbent glass on the wire retainer, install a frosted enlarger bulb, and you're ready to go.

You'll find that exposure time is much reduced, and that there's a new world of sharpness and detail in your photos. So far I haven't found any hot spots, and the con-

verted enlarger covers a $2\frac{1}{4}$ " by $3\frac{1}{4}$ " negative as well as the original did.

It didn't take me long to discover that the glass negative carrier would have to be discarded. Dust, lint, and finger marks that were not visible before now stood out clearly. Another trip to the photo supply house for a glassless carrier solved this problem.

Movies Shown on Ceiling by Double Reflection



Two mirrors located in a pentagonal metal or cardboard box will enable you to project movies on the ceiling for a bed-ridden person. It's best to use first-surface mirrors, for the glass face of the ordinary type will cast ghost images.

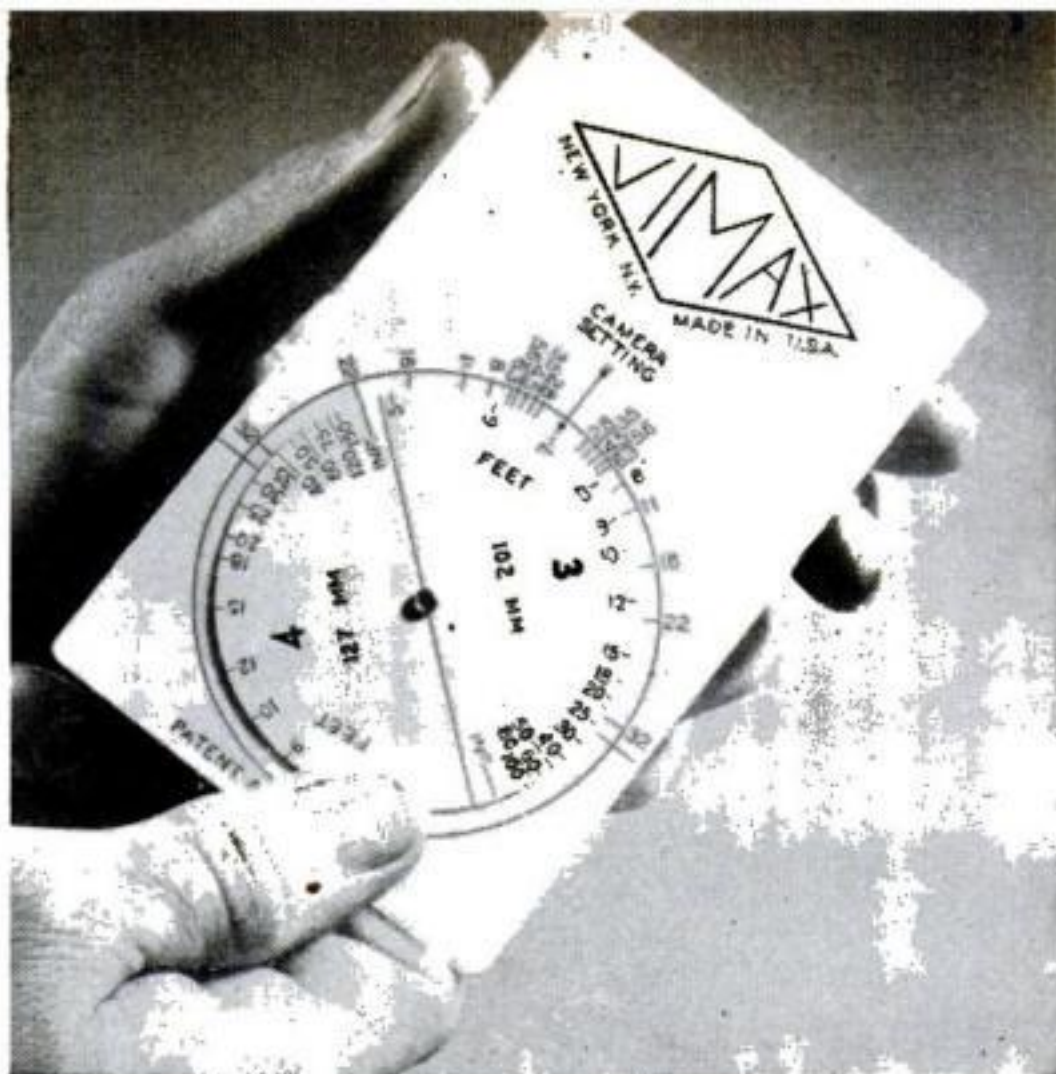
Lay out the pattern either on tinplate or cardboard, making the square about $\frac{1}{2}$ " more

than the diameter of the lens barrel. After bending on the dotted lines, solder or cement the edges, depending on the material. A sleeve to fit the barrel may be turned from metal or built up around a tubular form with successive layers of glued paper. The mirrors may be held in place with clips or an adhesive.—Herbert Dawkins, Baltimore.

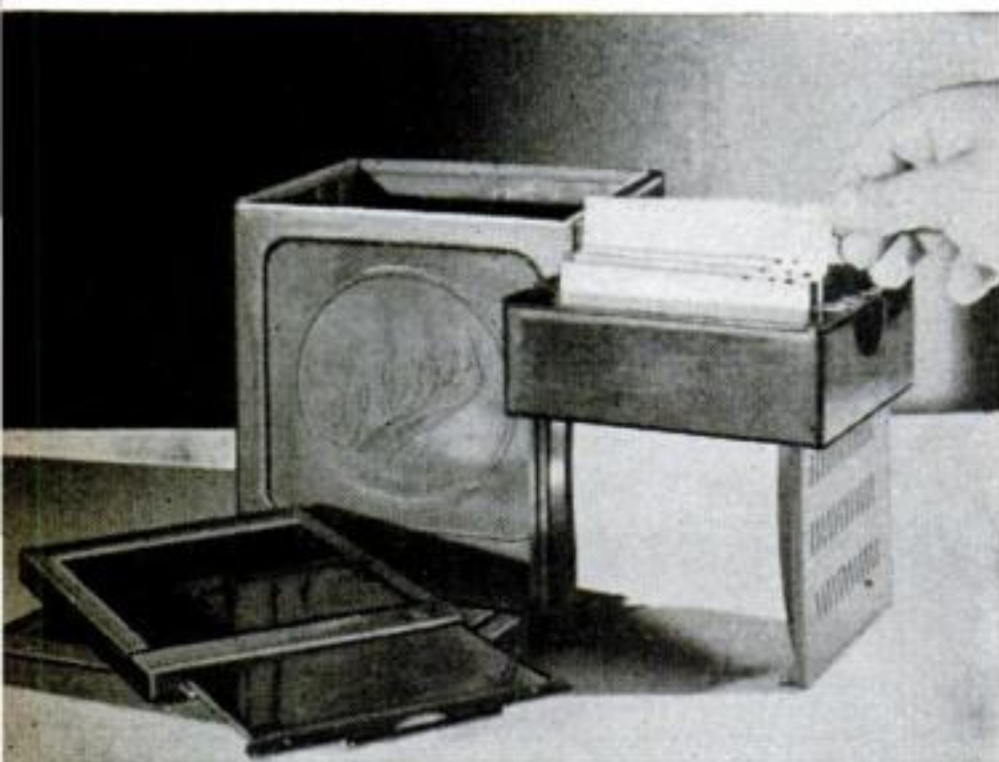


PHOTO IDEAS AND EQUIPMENT

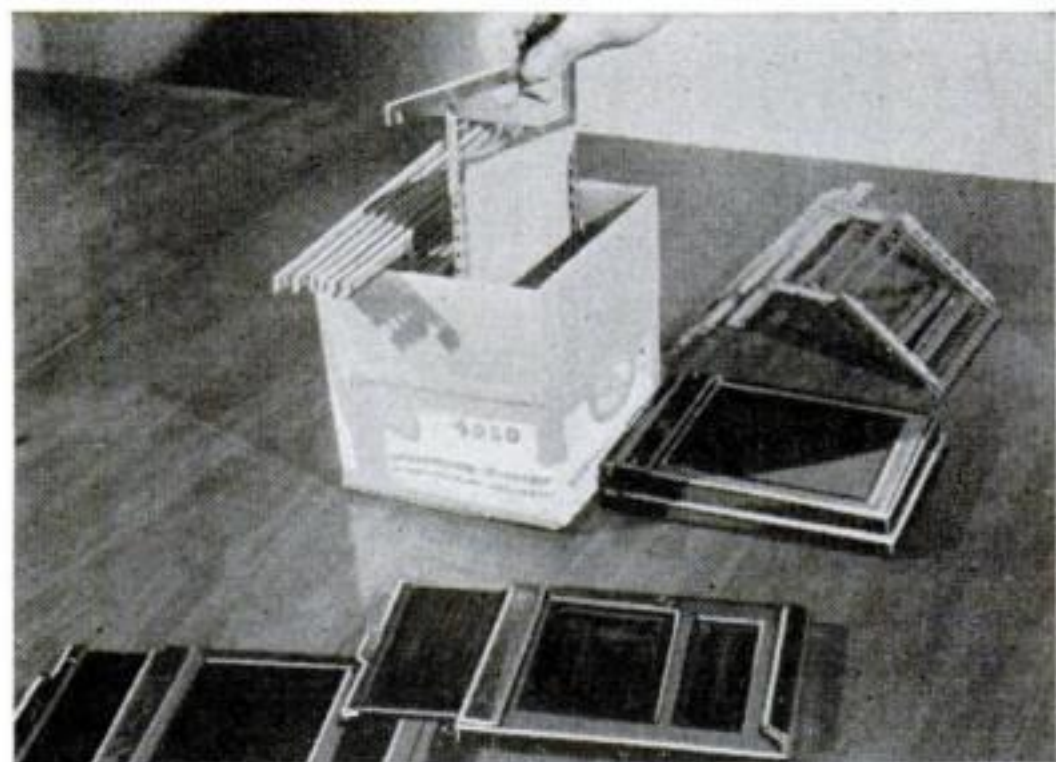
Box Camera in Reflex Form. In the new Kodak Duaflex camera the styling of a 2¼" by 2¼" reflex is combined with the operating simplicity of a box camera. Using 620 film, the camera takes 12 exposures on each roll, the fixed-focus lens recording detail sharply from 6' to infinity. On the upper surface is a large reflecting viewfinder for framing the picture. Fitted with built-in synchronization, the camera sells for about \$12 and an accessory flash reflector for about \$2.50.



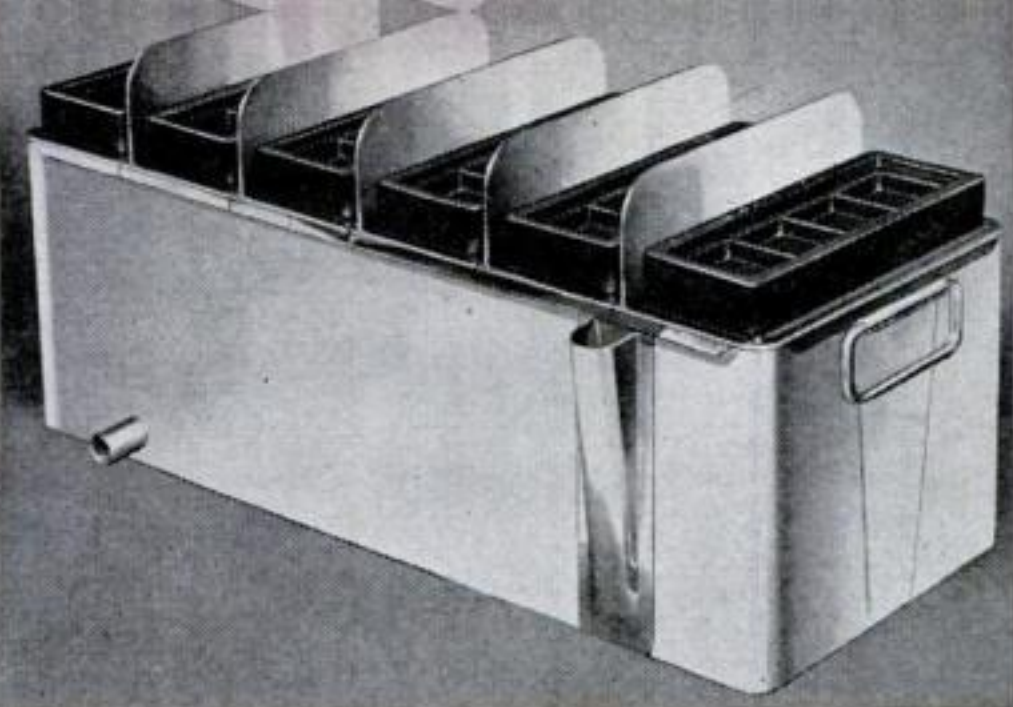
Guide Shows Depth of Focus. A pocket guide made by the Vimax Company, of New York, has two scales on either side to show the depth of focus covered by lenses of different focal length. Turn the dial until the distance at which the camera is focused is at the arrow (7' above), and then the distance shown between corresponding "F" stops at the right and left is in focus for the stop selected (for instance, from a little over 5½' to 9' at f/11 above). The guide is suitable for lenses of different focal lengths.



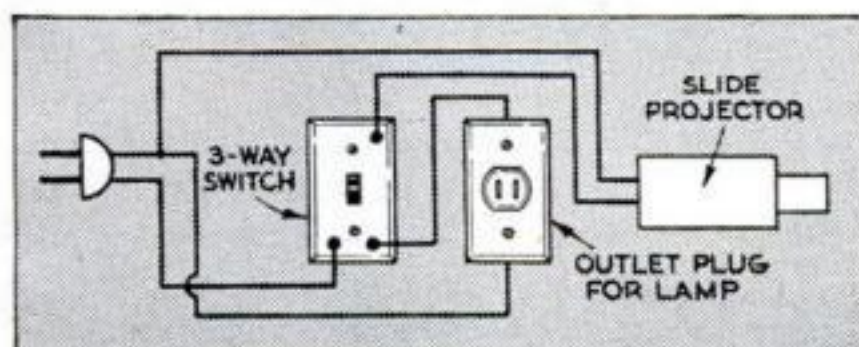
Film Loaded by Touch. Tanks with slot guides can be confusing in the dark when you forget how many films you've loaded and don't know which slot to use next. However, if each film is allowed to protrude slightly you can tell by feel where to insert the next. After all are in, you can then push them down to normal position.



Box Holds Loaded Hangers. Where to place cut-film hangers after they're loaded for developing often is a problem. One solution is to have on hand a cardboard carton about the size of the developing tank. As each hanger is loaded, it can be suspended in the box. Then when all have been loaded they can be put in the tank.



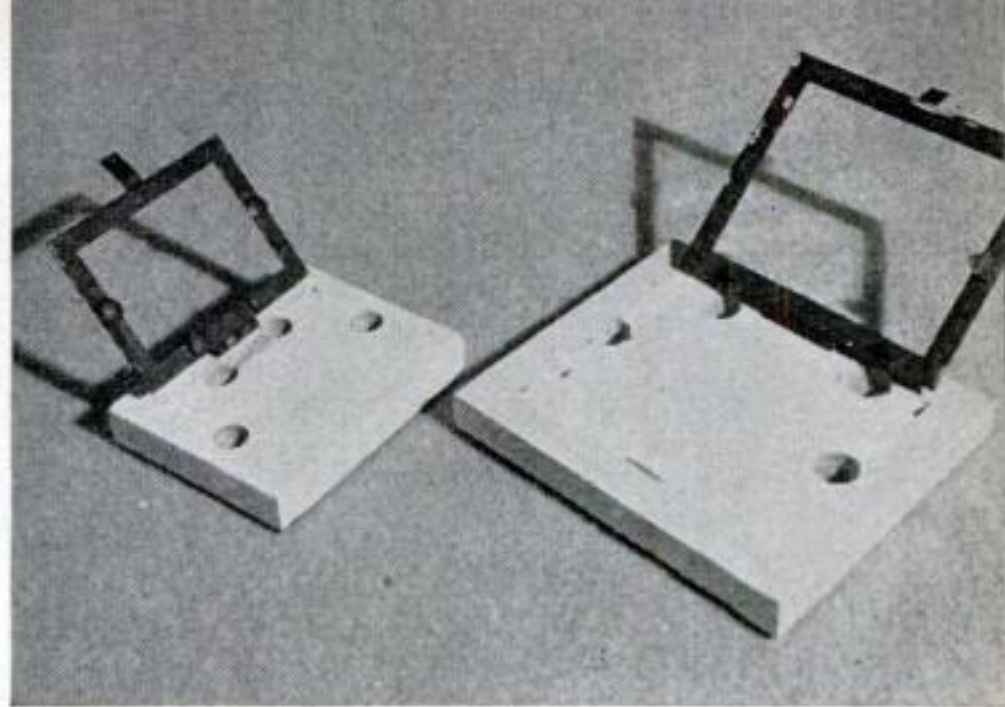
Color Developed in One Unit. A developing outfit that meets requirements for home processing of color is offered by the Morse Instrument Co., of Hudson, Ohio. Water heated to the proper temperature circulates around the hard-rubber insert tanks and a thermometer well also serves as an overflow spout. Splash shields are located between each of the tanks.



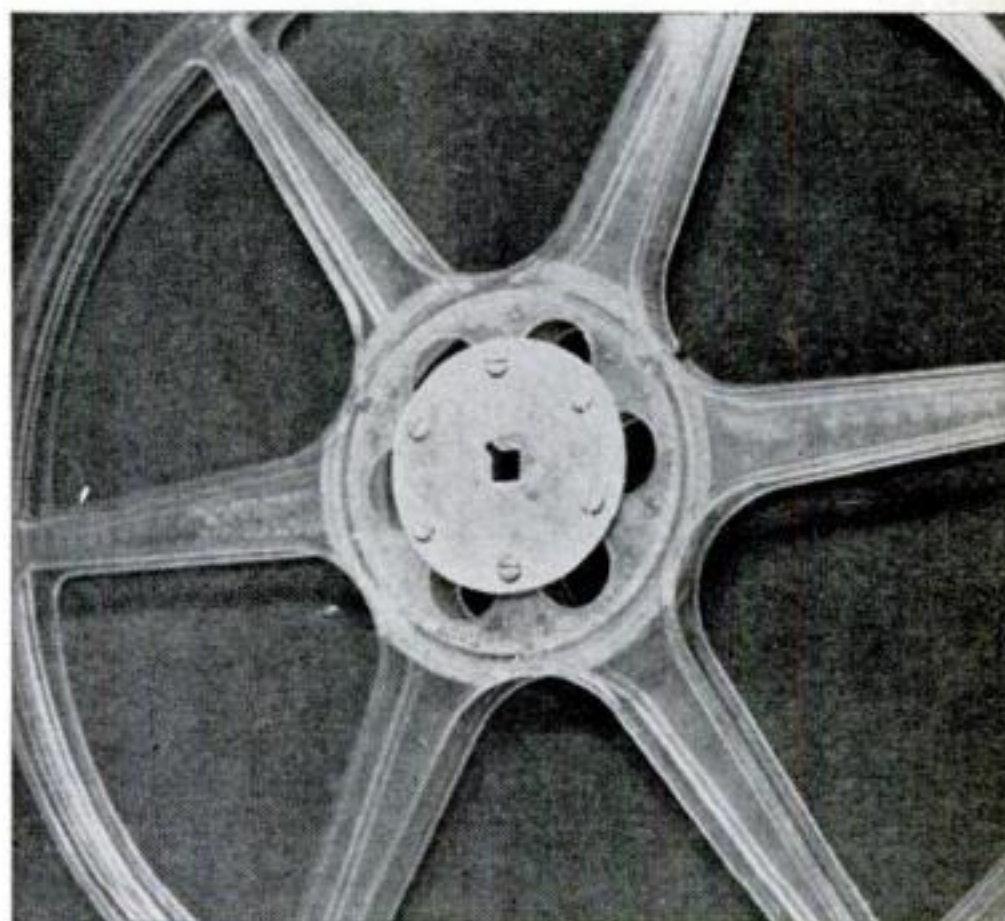
Lights Off, Projector On. Tired of stumbling around in the dark hunting for light switches, I wired my slide projector, a light, and a double-throw switch as above. Now when I flip the switch the light is turned off at the same time the projector is turned on, while flipping the switch the other way turns the projector off and light on.—*Thomas R. Osborn, Oakland, Calif.*



Box Improves Changing Bag. If a cardboard box of suitable dimensions is thrust into a changing bag, film loading will be a lot easier. The box will keep the bag up out of the way and provide a free, roomy working area for placing the film in the holders. Box, holders, and film should be zipped inside before the arms are inserted.



Easels Give Even Borders. Here are a couple of easels that provide a quick way of positioning the paper to get even borders when you're making small enlargements. On each, a metal frame with inner dimensions $\frac{1}{4}$ " less than the finished print is hinged to a white focusing board. One frame has small metal angles soldered underneath to hold the paper loosely; thumb tacks were soldered into tiny holes drilled in the other. After focusing, paper is slipped in and the frame is lowered, the angles or tack heads going into holes drilled in the board.—*D. H. Thompson, Waterbury, Conn.*

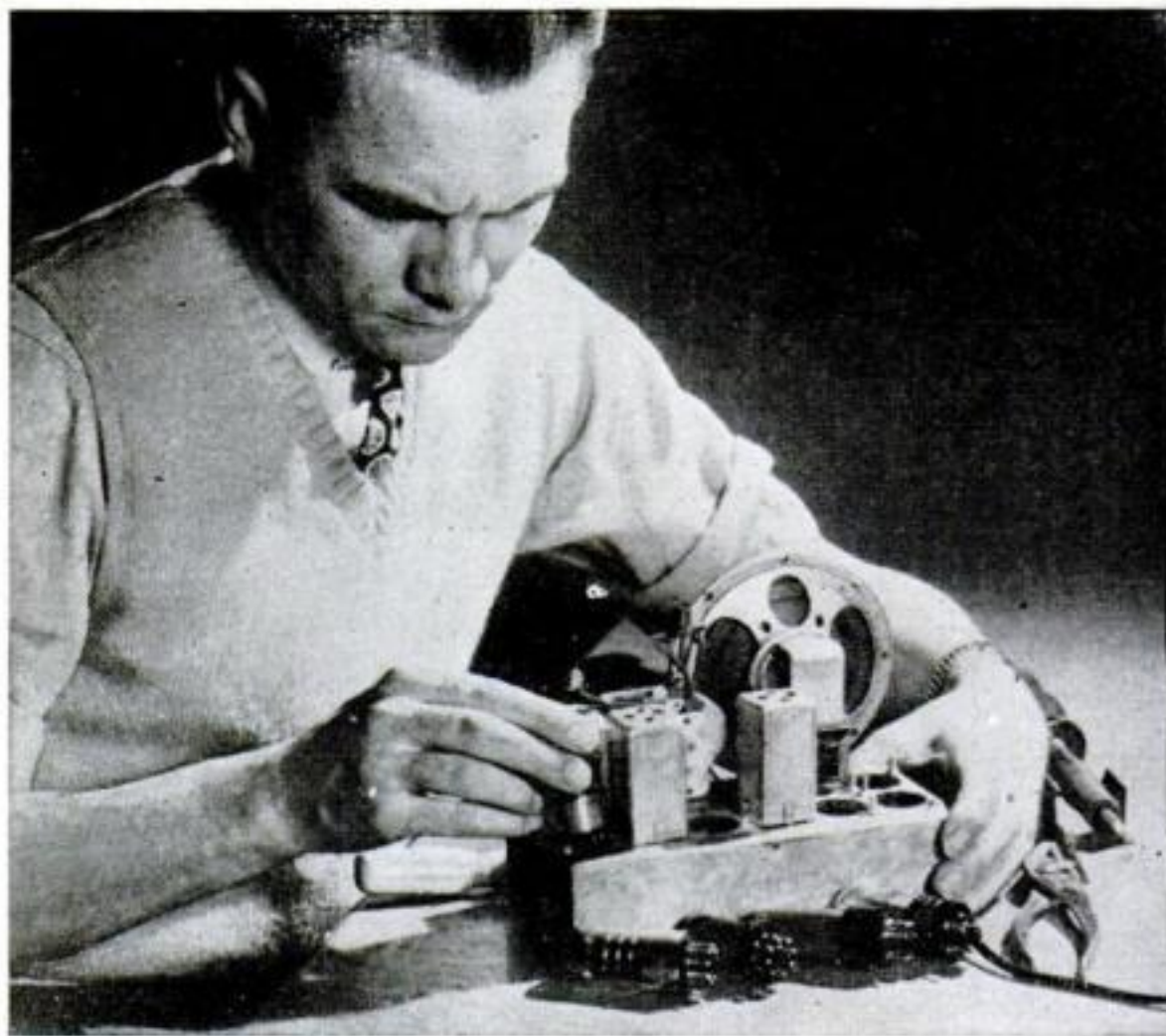


New Flange Salvages Reel. The square hubs of 16-mm. movie reels or the slots of 8-mm. reels sometimes become worn by use, especially if made of plastic. Such reels can be repaired by cutting a circular cover flange from scrap aluminum, making it slightly smaller than the inside film roll. In the center, drill a hole and file it square—or make slots, as the case may be. Mount with screws.—*William Jordan, Oil City, Pa.*

A Superhet the Beginner Can Build

Never built a radio? Tune in on this hobby now with these plans for a five-tuber anyone can make.

**By a High-School
Shop Teacher**



DO VOLTS scare you? Are you *sure* you can't get to first base with radio? Your answer to these questions should be a thumping "No!" If it isn't, someone's kidding you.

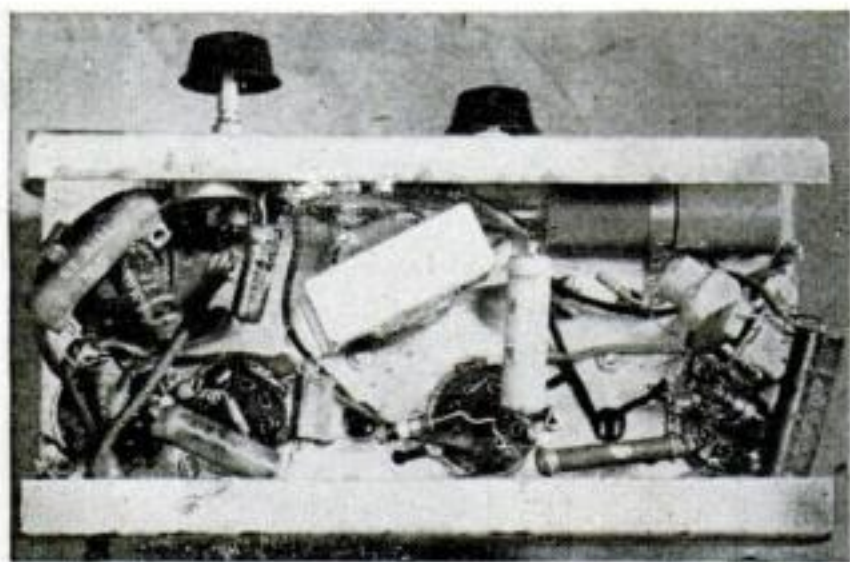
I'm not guessing about it. As a shop instructor, I've met hundreds of beginners who were so scared of an ohm they'd hide under a table whenever one crawled out of a circuit. Yet within a few weeks the most timid of them was sporting a receiver he'd built from scratch.

When I say they made receivers, I mean the same 5 tube AC-DC superhet you see here. But isn't it wiser, you may ask, to start off with a simple one-tuber? I don't think so. It's no harder to hook up five tubes than two—you just work a bit longer. And when you've finished, you'll have a sweet little

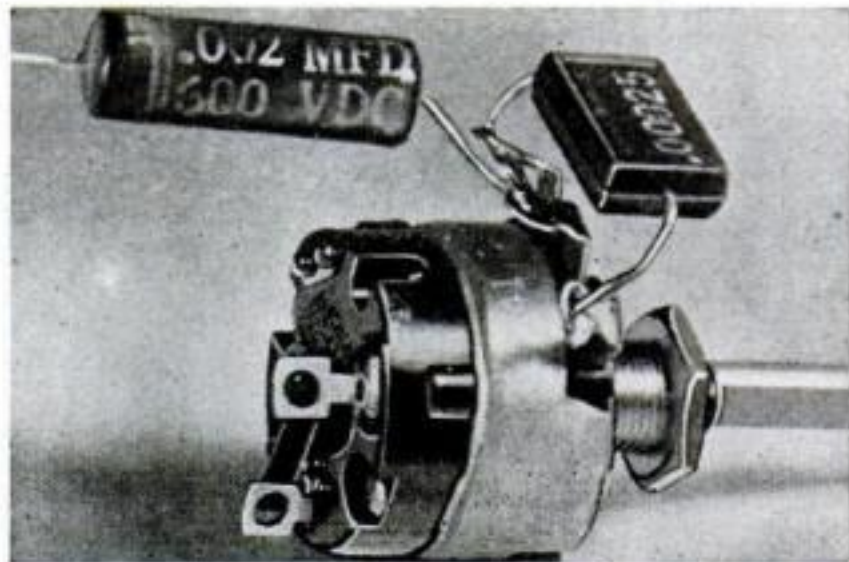
set with plenty of power and sensitivity. It's even got automatic volume control, something you won't always find on small sets.

The superhet circuit is a highly efficient one used in scores of commercial designs. It has a few more parts than some others, but they're standard and easily obtained. If you're remote from radio shops, the mail-order radio houses have all you'll need. Your parts cost may be as little as \$12, and your time investment will probably run from four to seven evenings.

What this radio—and any other—has to do is to select the signal of a station you want to listen to, separate the audio modulation (electric vibrations at sound frequencies) from the high frequencies that have carried them through space, and then fatten them



Bottom of the completed set. Follow this and the pictorial diagram in laying out the parts.



Soldering can be simplified by making all convenient connections before mounting parts.

up to loudspeaker volume. A superhet has a baby transmitter of its own, consisting of an oscillator coil and a mixer tube, which generates a radio signal that's used to convert *any* broadcast signal to a standard frequency of 456 kc. This is lower than the broadcast range but not yet in the audible range. It's intermediate, so the transformers and amplifiers that boost it are called intermediate-frequency (IF) transformers and stages. What skims off the low audio frequencies is the detector (part of the 12SQ7 tube in the diagrams), and they are then beefed up by a husky beam-power tube, the 50L6.

Sure, the schematic circuit at the top of page 225 looks complicated. But you've only got to follow one line at a time! Here each part is shown by a symbol—fixed condensers by two thick parallel lines, trimmer condensers by one line and a thick curved arrow, and variable tuning condensers by a straight arrow through a straight and curved line. The letter C refers to condensers that are numbered with the parts list; and R identifies resistors, which are zigzags in the circuit. The springlike symbols are coils or (when paired) transformers.

Those heavy ovals are tube symbols; inside, from the bottom up, are the cathode, one or more grids (thick dotted lines), and the plate. But all you really need to remember is to make the connections to the proper pins on the sockets. Looking at the *bottom* of the socket, these are always numbered clockwise from the little notch or key in the center hole. Connections to the heaters, which make the tubes glow, are separate from other wiring, so they're shown at the bottom of the diagram with just the pin numbers for each of the tubes.

Schematics are drawn in a kind of elec-

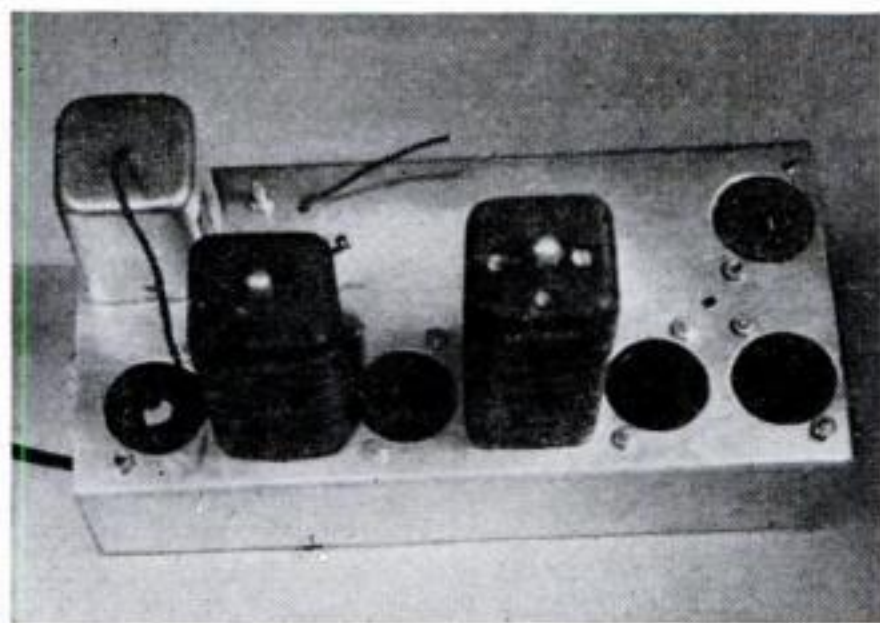
tronic shorthand that you'll pick up fast. Meanwhile, a pictorial diagram of the same set may prove a help, since it suggests what the parts look like and where to put them. It's at the bottom of page 225.

In buying parts, be cautious about accepting substitutions, even if a salesman tells you that the exact value of a part isn't important. Don't use paper condensers where mica ones are specified, or resistors of lower wattage rating than called for. Be sure you buy an oscillator coil with four leads. The IF transformers should have trimmer condensers attached inside the can. I recommend Bakelite $\text{\textcircled{T}}$ octal sockets having a metal frame with ground connections next to prongs 1 and 5, rather than the cheaper wafer sockets.

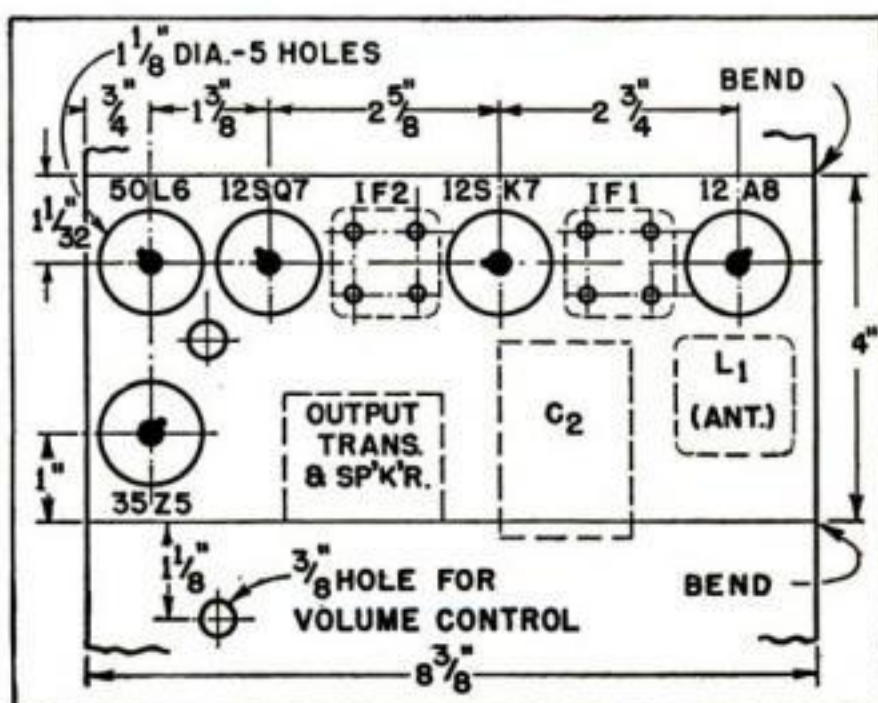
The tuning condenser is a two-gang cut-plate type; that is, it has one 27-plate section and one 19-plate section. It should also have built-in trimmer condensers—tiny screw-adjusted ones used in aligning later.

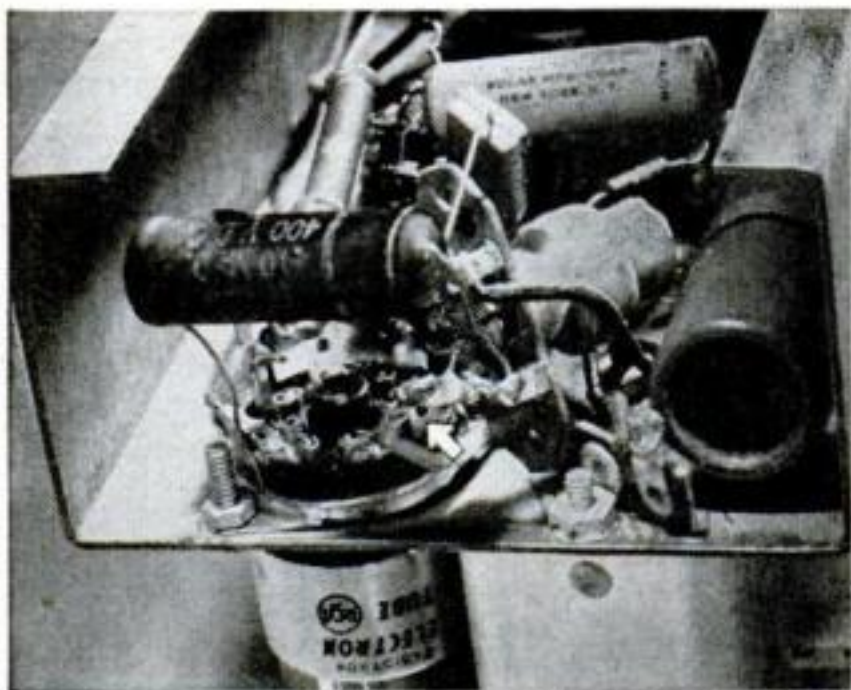
Either a permanent-magnet or a dynamic speaker can be used. The latter has an electromagnet, the field coil of which will serve as the filter choke (L3), while with a PM speaker you'll need a separate choke. Some builders use a 1,000-ohm 5-watt resistor in place of the choke, since it costs less and takes less space, but a choke cuts hum and gives better tone.

While we're on the subject of choices, there's another that you may want to consider in building the set. The lower left part of the schematic diagram shows an alternative to the 35Z5 rectifier tube. Selenium rectifiers are gaining popularity as rectifier-tube replacements because they give trouble-free service, don't have to warm up as tubes do, and need no heater supply. Since the heaters in this set are connected in series,



Top of the chassis with sockets and coil cans mounted as called for by the template, right.





Arrow points to the plate (blue) lead of the oscillator coil, soldered to pin 6 of the 12A8.

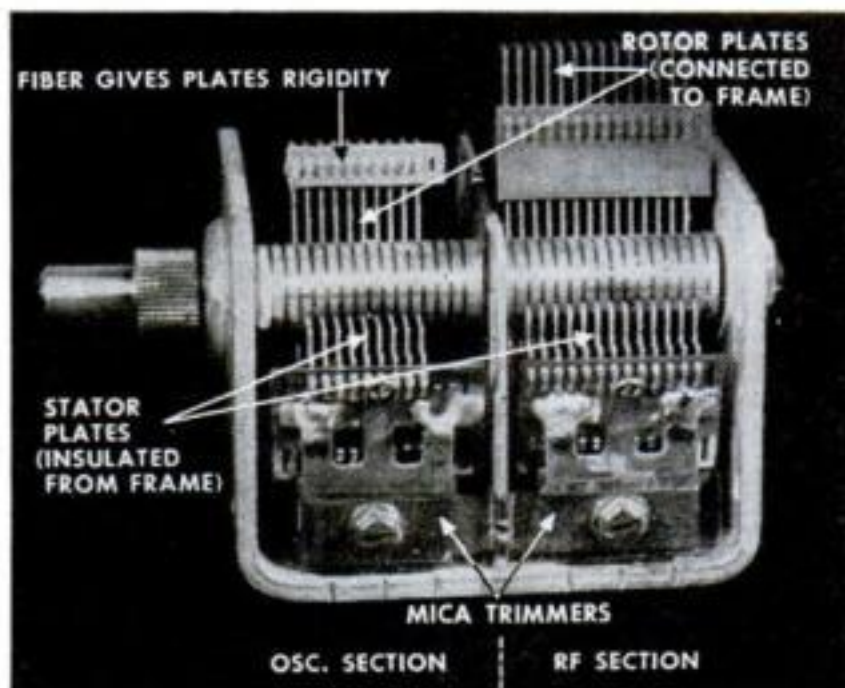
you'll have to insert the additional resistors R11 and R12 if you omit the rectifier tube.

And now let's get down to building. For a neat chassis arrangement, draw a full-size chassis template, paste it on a flat piece of aluminum, and punch and drill all holes. A No. 28 drill is right to clear the 6-32 screws used to mount all parts. Take pains in making the holes for the tube sockets, since the big central hole and the two mounting ones must be in line. While the 1½" socket holes can be cut on the drill press with a hole cutter, a chassis punch is much easier. Bend in the sides and letter on the tube numbers for each socket. Many radio supply houses sell prepunched chassis that'll do nicely.

Don't mount the tuning condenser and speaker right away, since they're both fairly delicate and might be damaged during work. Inasmuch as you're using a 12A8 tube in which the signal-grid comes out to a cap at the top, use an antenna coil that has a hole in the top of the shield can for this grid lead. When installing the IF transformers, orient them so that the plate and grid leads are as short as possible. Follow the color coding; the blue one goes to plate, red to B plus, green to grid, and black to the AVC line.

Note the four holes to be drilled through the chassis under each IF can; they allow the leads to be brought out singly for maximum separation. Grid and plate leads of IF transformers must be cut as short as possible, and kept away from each other and close to the chassis. If they *must* cross, see to it that they cross at right angles.

Construction will go most smoothly if you complete all chassis drilling and punching first, and have all parts at hand before you



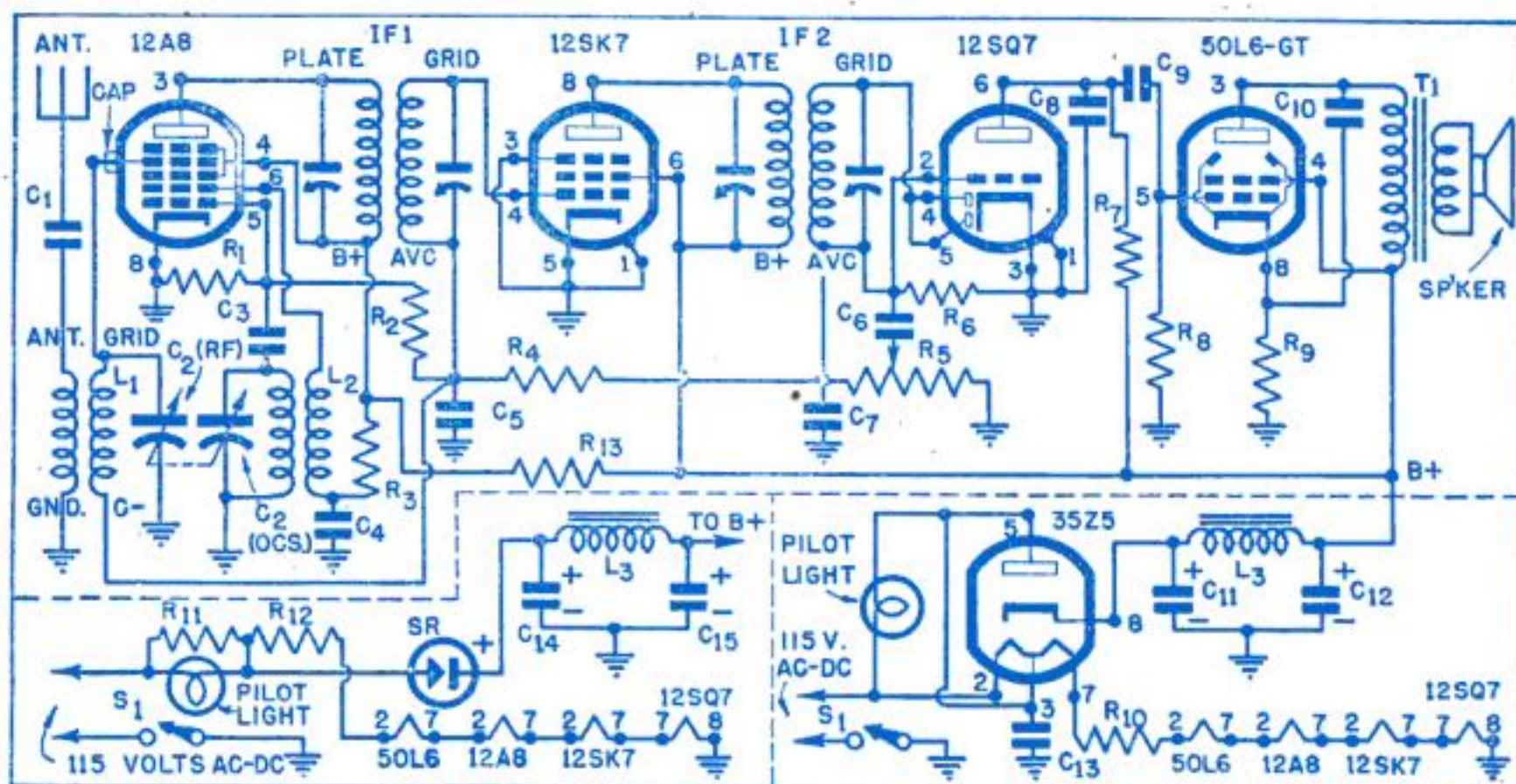
Cut-plate, two-gang tuning condenser, showing basic elements. Make sure yours has trimmers.

begin. Many parts can be wired before they're mounted on the chassis. For example, mica condenser C7 is shunted across the outside terminals of the volume control (R5) before the latter is mounted. One end of C6 is similarly attached. Making connections out where you have plenty of room renders assembly easier. Make all leads as short as possible, and don't be afraid to crowd parts together.

It's also a good plan to wire each separate part of the circuit with different colored wire. Circuits are commonly coded like the IF leads—blue for plate, and so on, plus yellow for the filament and brown for cathode circuits. Pushback wire, the kind most convenient to use, comes in these colors. The logical wiring sequence is: heaters, cathodes, screen grids, control grids and diode plates (pins 4 and 5 of the 12SQ7), AVC leads, and the B-plus circuits.

Note the location of the dual electrolytic condenser C11 and C12 in the pictorial diagram—as far as possible from the 35Z5 and the 50L6 tubes. These are the ones that generate most heat, and heat is bad for electrolytics. These condensers must be connected with the correct polarity; they're ruined by reversed polarity. Run the black lead to ground and the red one to the plus side. If the leads aren't colored, the ground lead comes from the end with a heavy black line. The value of this dual electrolytic isn't critical; anything from a 16-16 mfd. to a 40-40 mfd. one will do. With paper condensers, the lead attached to the outer foil is the one to be grounded if either one is. In the case of the tuning condenser, it's the terminals of the rotor section that go to ground.

TO BE CONTINUED

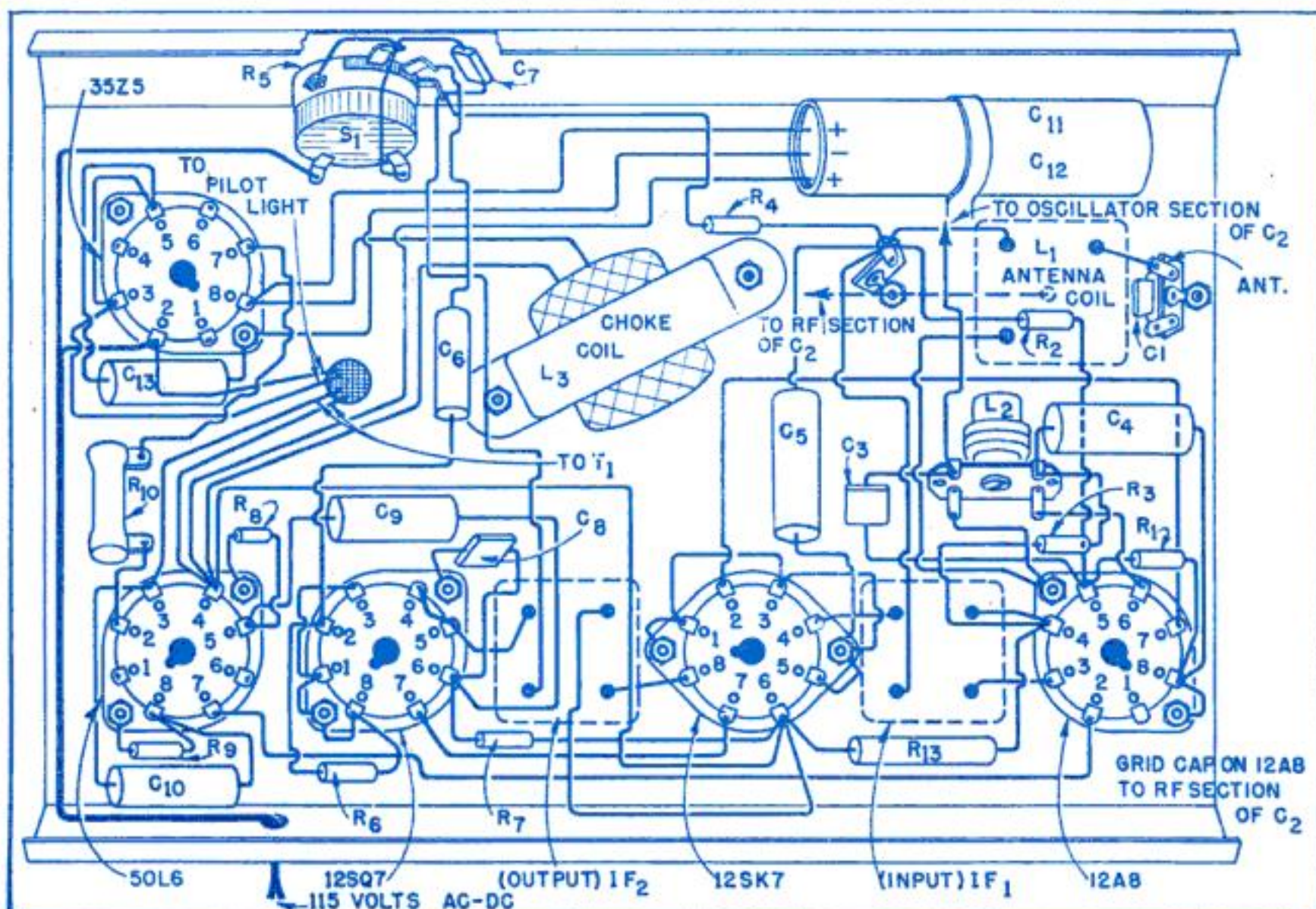


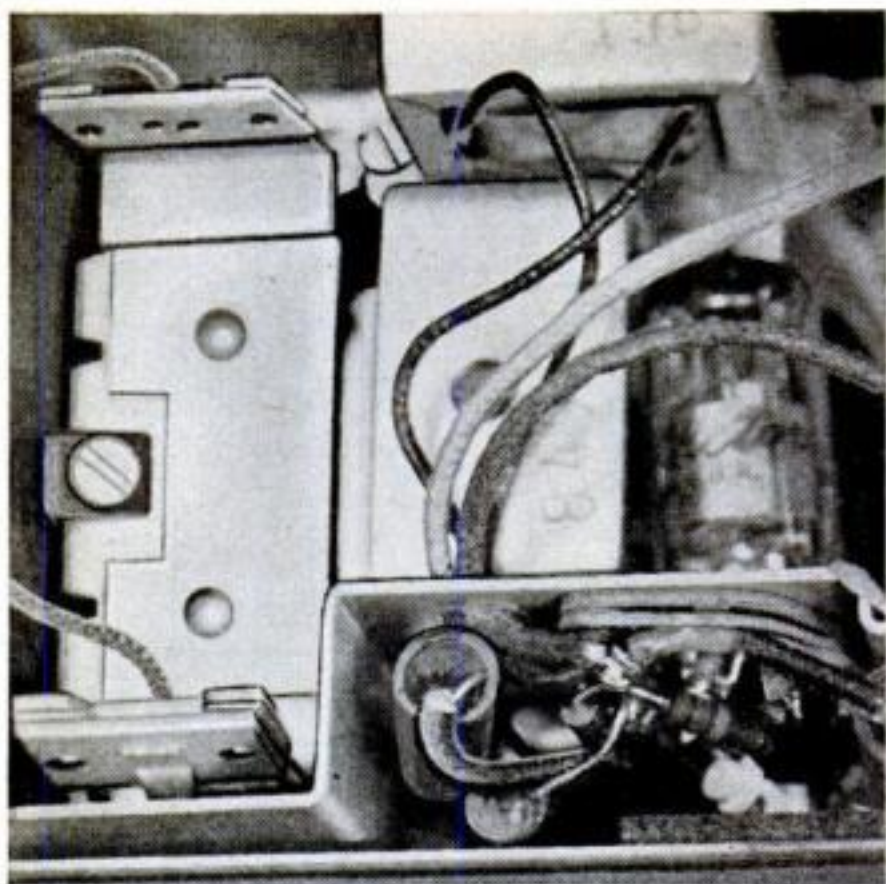
LIST OF PARTS

All resistors $\frac{1}{2}$ -watt carbon unless otherwise specified.
 R1: 50,000-ohm. This is critical.
 R2, R6: 15-meg.
 R3: 20,000-ohm.
 R4: 3-meg.
 R5: 500,000-ohm pot (with switch).
 R7, R8: 500,000-ohm.
 R9: 150-ohm.
 R10: 30 to 50-ohm, 10-watt wire-wound.
 R11: 22-ohm, 10-watt wire-wound.
 R12: 200-ohm, 10-watt wire-wound.
 R13: 50,000-ohm.
 All paper condensers 400 volt unless otherwise specified.
 C1, C7, C8: .00025-mfd, mica.

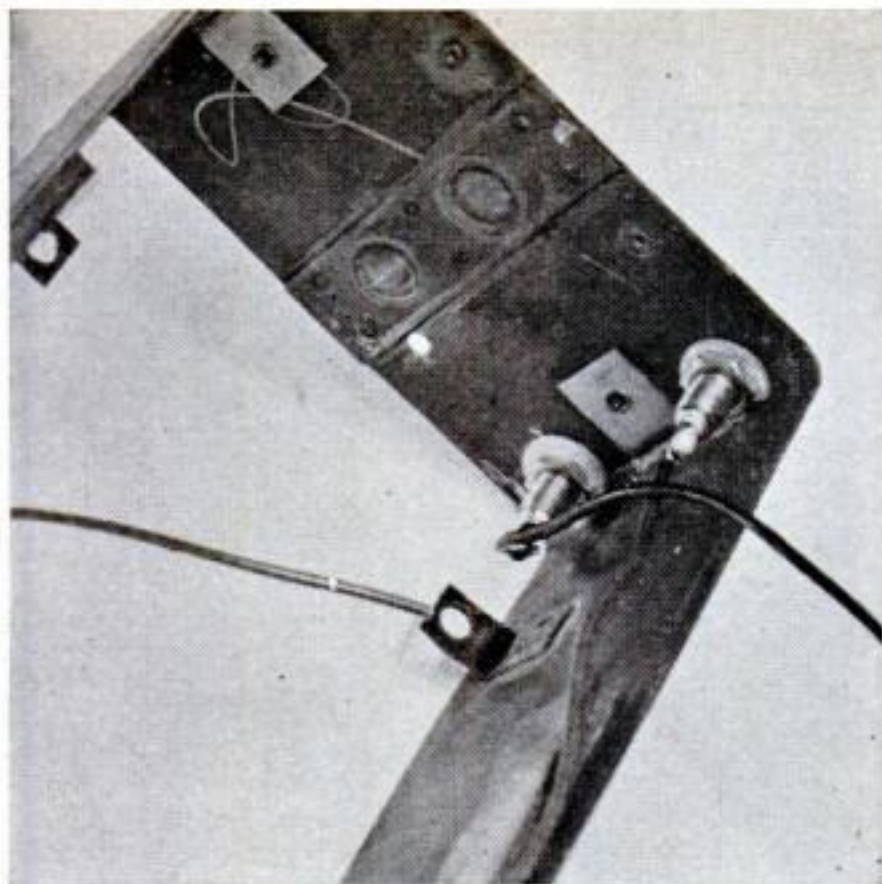
C2: two-gang, cut-plate variable condenser for broadcast band and 456 kc. IF.
 C3: .0001-mfd, mica.
 C4: .1 mfd, paper.
 C5, C13: .05-mfd, paper.
 C6: .002-mfd, 600-volt paper.
 C9, C10: .02-mfd, paper.
 C11, C12: 20-20-mfd., 150 volt dual electrolytic.
 C14, C15: 40-40-mfd., 150 volt dual electrolytic.
 L1: Shielded ant. coil with trans. windings. Grid lead should come out at top of shield can.
 L2: Four-lead, 455-6 kc. osc. coil.
 L3: 400-ohm, 15 to 30-henry, 75-ma.

choke coil, or 450-ohm field coil on dynamic spkr.
 IF 1, IF 2: Input and output shielded intermediate-frequency transformers for 455-6 kc.
 T1: Output trans., to match 50L6.
 S1: SPST switch on R5.
 SR: 100-ma. selenium rectifier.
 Speaker: 6" PM or dynamic.
 Pilot light (6-8 volt, .15-amp., No. 47) and bayonet socket; prepunched chassis or $8\frac{3}{8}$ " by 9" sheet aluminum; line cord; tubes; octal sockets; nuts; bolts; misc. hardware.
 Note: With 35Z5 rect., omit R11, R12, C14, C15, SR; with selenium rect., omit R10, C11, C12.





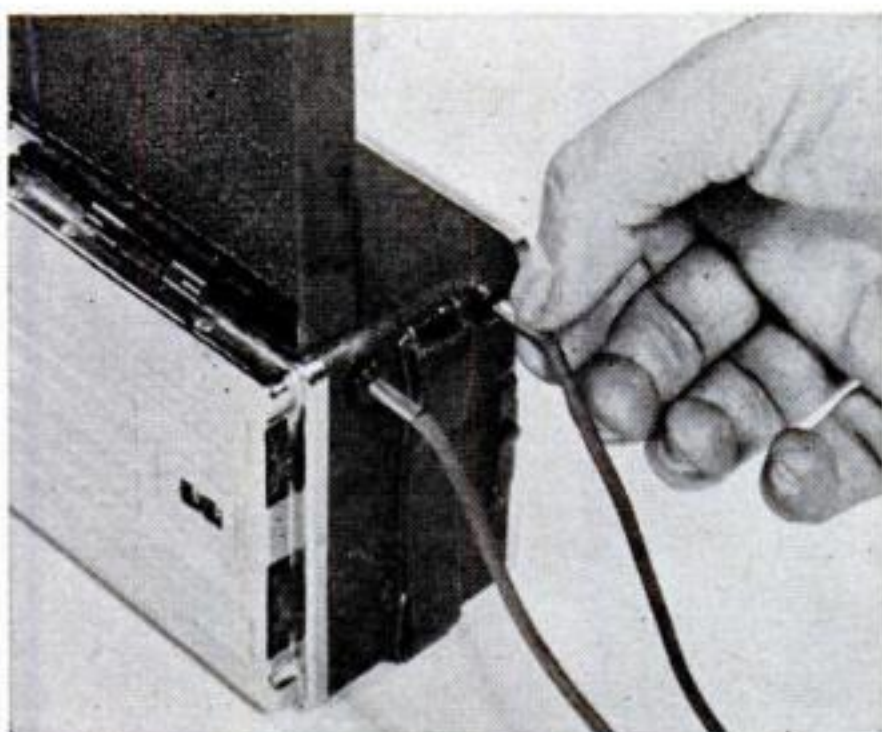
Connect wires to both ends of the A-cell clip shown at the left. One side of it is grounded.



One of the phone jacks must be insulated from the case. This will go to the A-plus terminal.

External Battery Runs Portable

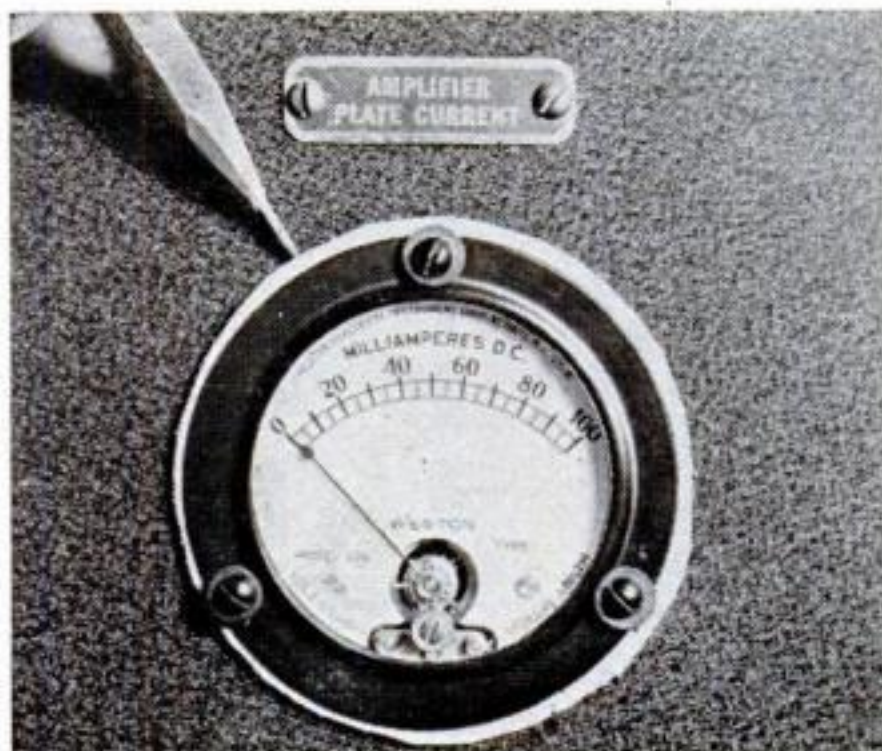
FLASHLIGHT cells, often used as the filament supply in midget portables, generally become exhausted long before the B batteries. If you have such a set that is mainly used about the home, you can save yourself the nuisance of frequent replacement by plugging in a large No. 6 dry cell. Such cells, commonly used with doorbells and lanterns, have a long shelf life and a high current capacity compared with D-size flashlight cells. For convenient change-over, install a pair of phone-tip jacks in the back of the portable, soldering leads from them to the regular inside cell clip. Be sure to remove flashlight cells when using the external supply, as one might discharge the other.—Arthur C. Miller, Manhattan, N. Y.



Remove the flashlight cell from its clip and then plug in the external 1½-volt battery leads.

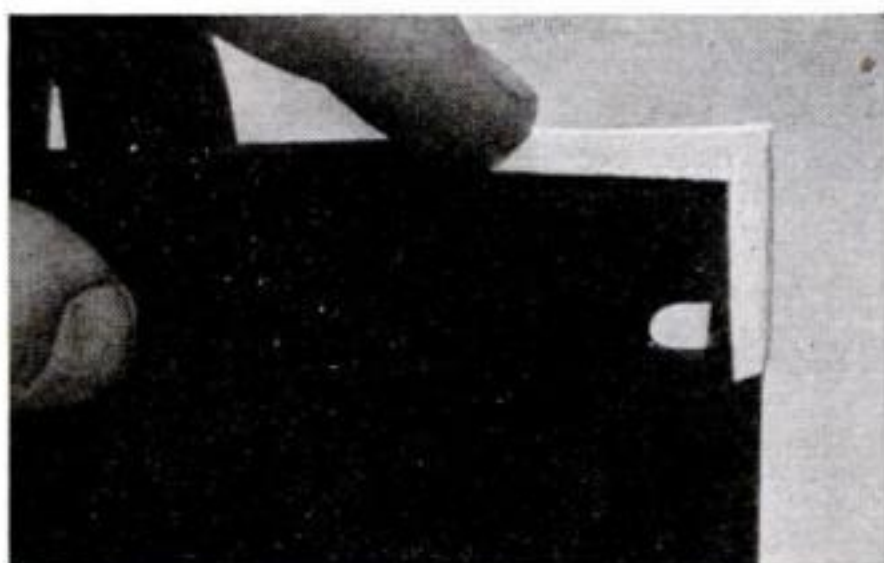
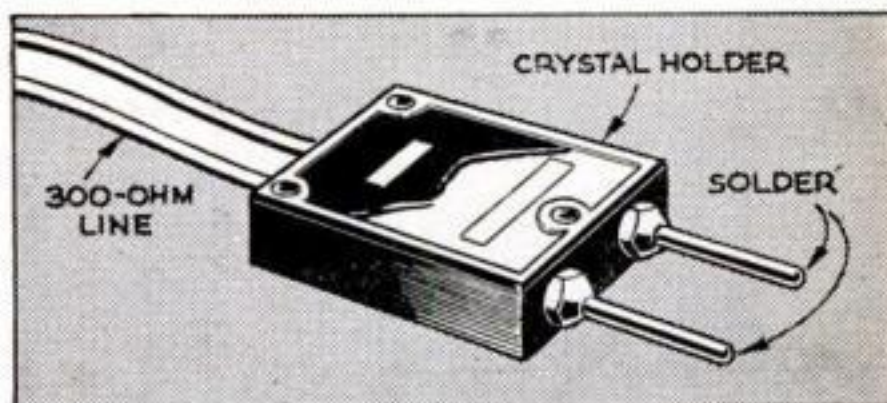
Gasket Allows Mounting of Grounded Meter

WHEN the rack-mounted meter in the final stage of a transmitter flashed over internally and grounded itself against its case, the meter had to be held off the panel to obtain correct readings. To do this, three layers of cellulose tape were first wrapped around the meter case and shanks of the mounting screws. A cardboard gasket, slightly larger than the flange, was inserted between the panel and the case. Fiber washers were used under screwheads.—D. J. Bachner, Jackson Heights, N. Y.



Low-Loss Antenna Plug Made from Crystal Holder

PARALLEL lead-in line can be connected to an FM or television receiver, without changing the impedance of the lead-in, by means of a discarded crystal holder. Cut and scrape the ends of the 300-ohm line and solder the tips into the holder prongs. Connect a suitable socket to the terminals in the set.—*Myron Bobbe, Bronx, N. Y.*



Tape Makes Corners Safe

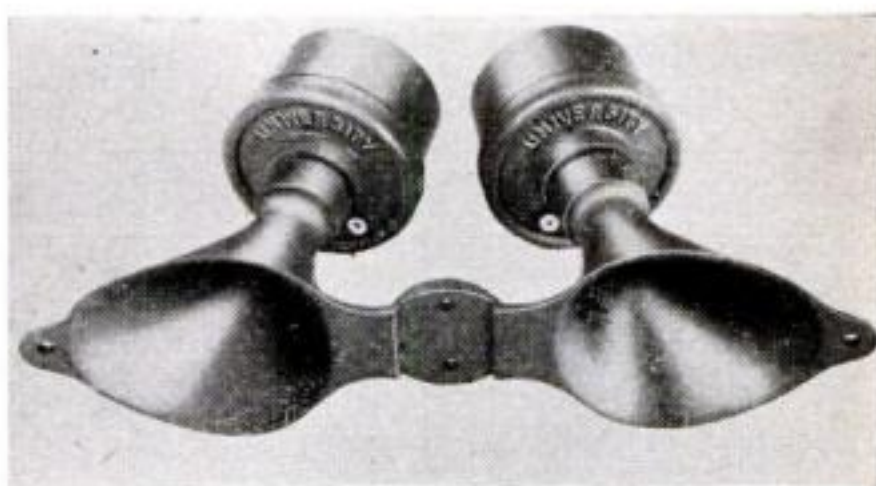
AFTER suffering some nasty cuts from the sharp corners on steel radio panels, one experimenter applied adhesive tape as above. Better as a preventive than a treatment, the tape is easily removed when work is done, and leaves no marks.

Fluid Patches Record Breaks

RECORD cracks that throw the needle back into the same groove can be repaired with mimeograph-stencil correction fluid. Clean the record well with a record brush, apply fluid, let it harden, and play the record with a fresh needle to cut new grooves through the patch. The needle should then track properly, although a click may still be heard as it passes the patch. Repeat patching treatment as needed.—*David Witt, Bronx, N. Y.*

Foil Shields Radio Tube

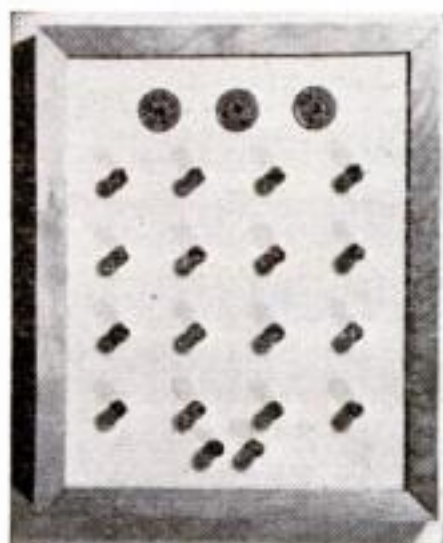
NOT having a tube shield of the right size on hand while you are working on a radio need not keep you from finishing the job. It is a simple matter to soak or burn off the metal foil from a package of cigarettes and wrap it around the tube. Fasten it with cellulose tape, and also tape a piece of wire to the foil so that it makes secure contact. Attach the other end of the wire to the chassis so as to ground the shield effectively.—*J. W. Cornell, Utica, N. Y.*



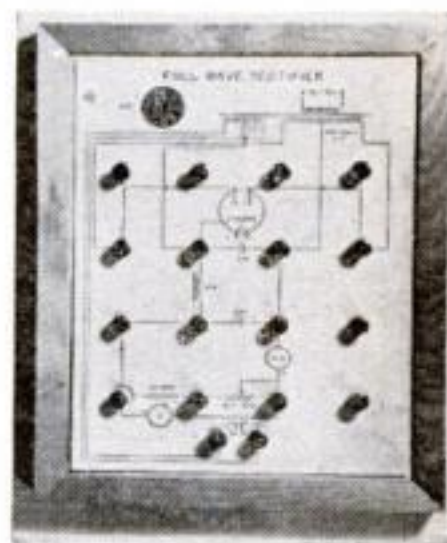
Tweeter Ups Speaker Response

A HIGH-FREQUENCY speaker said to reproduce the 2 to 15-kc. sound range is made by University Loudspeakers, Inc., New York. It can be attached to an existing 12" speaker merely by connecting two wires, without extra set connections or a dividing network.

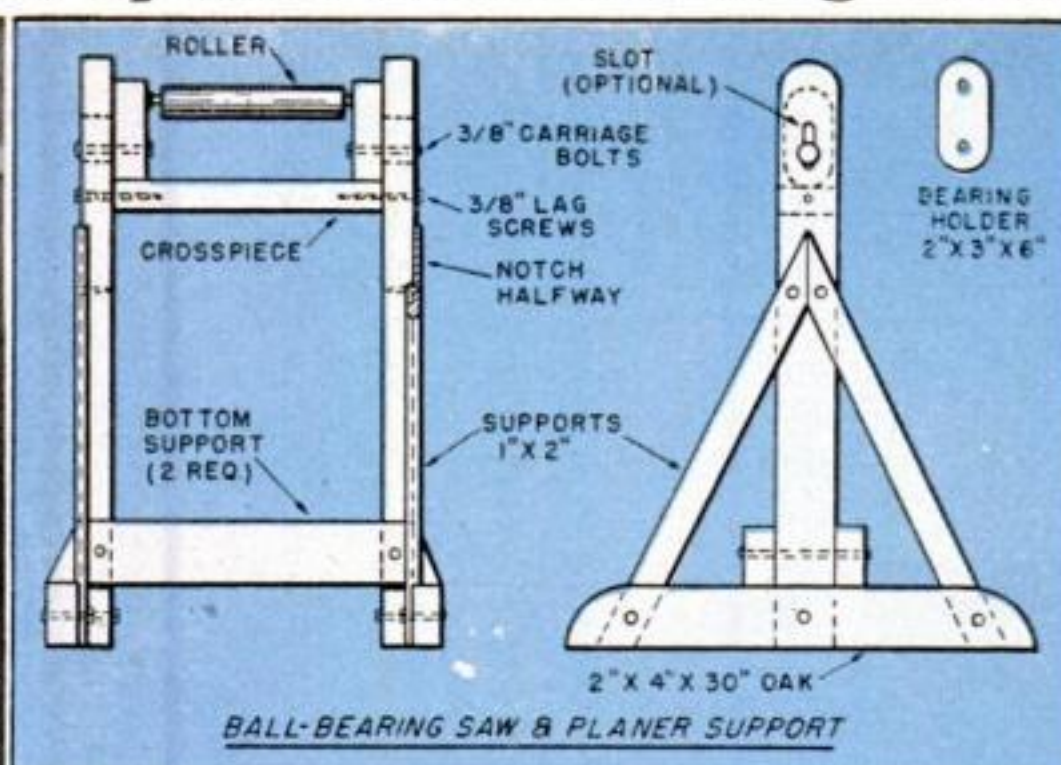
Electronic Circuit Panel Speeds Experiments



MANY laboratory and school experiments can be performed on this panel containing three wired octal sockets and a variety of interconnected terminals. The board is furnished with 23 keyed diagrams that fit the top of the panel. They are said to cover fundamental experiments in vacuum and gas-filled tubes. Each circuit details the connections that must be completed. Kepco Laboratories, Flushing, New York, is the maker.



Ball-Bearing Support Speeds Work on Long Stock



EVER wrestle with a 10' piece of lumber while you tried ripping it on a circular saw? If you have, you must have wished for a third hand (with a mighty long arm) or a roller support just like this. The ball-bearing roller makes even the heaviest work glide on or off the table of the saw, planer, drill press, or other machine on which you use long stock. A washing-machine roller was picked up at a junkyard. Plenty of them are to be found, so select one with its bearings intact and the rubber surfaces in fairly good condition. Make sure you get the bearing retainers, too. Clean the parts and oil sparingly.

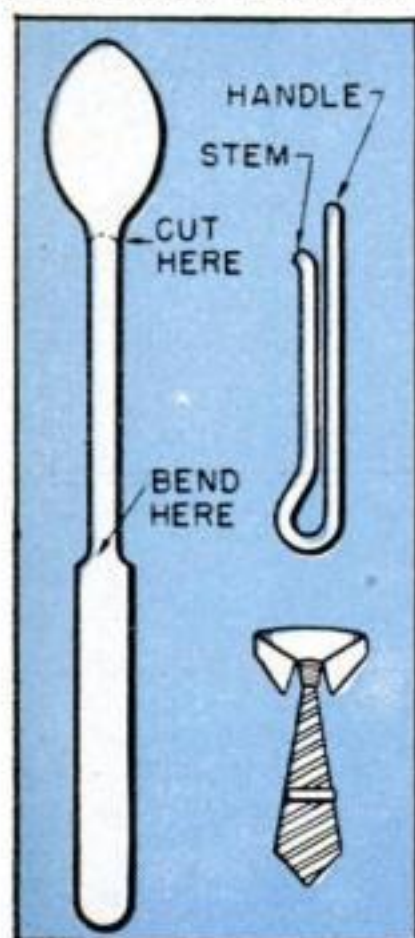
Adapt the width of the support to the roller you can get, and its height to that of the machine table. Mortise the bearings in

2" by 3" by 6" holders. Use hardwood for the stand if possible, because the extra weight will be an advantage. Fasten all joints with $\frac{3}{8}$ " carriage bolts or lag screws as indicated.

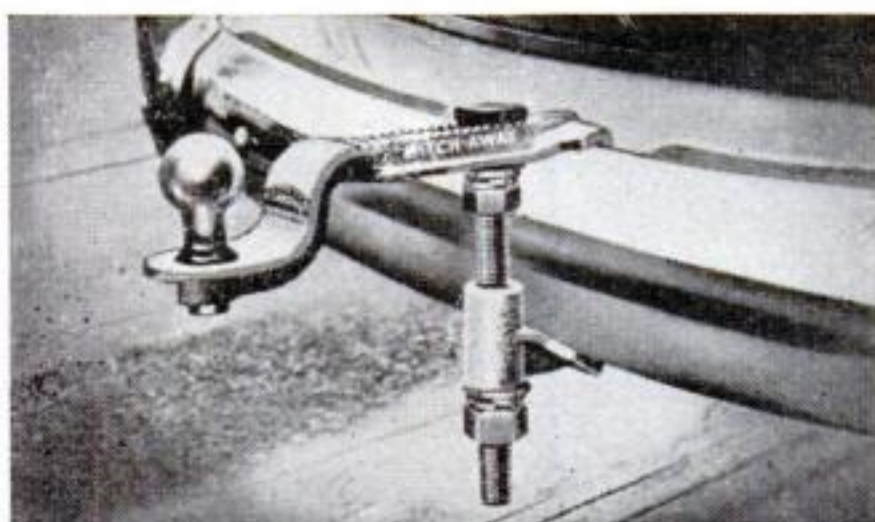
Complete the sides first and mount the bearing holders by bolting them in slots. These slots will allow you to vary the roller height according to the adjustment of the table or to suit slightly different machines. —William D. Jackson, Knox, Ind.



Plastic Drink Mixer Clips Tie

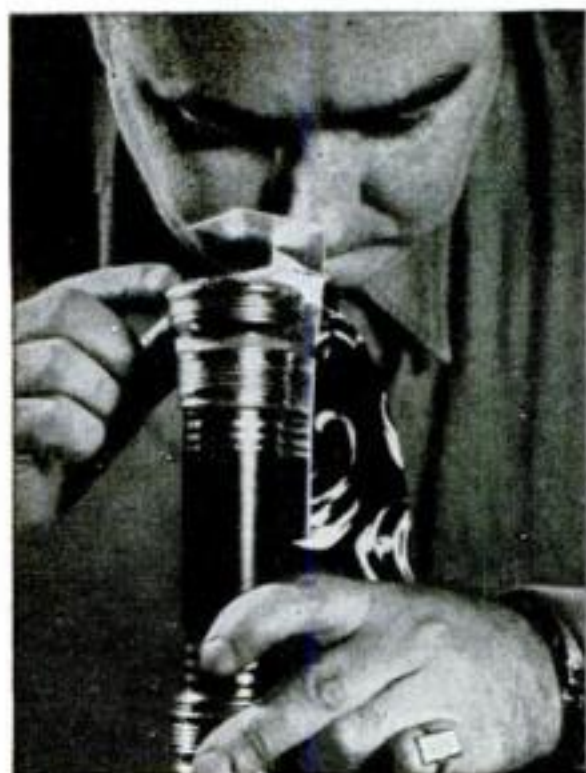


PLASTIC drink stirrers of the spoon or spear type can be readily made into novel tie clasps. Cut off the spoon and bend at the point shown by submerging the plastic into hot water and applying light pressure. Dip the piece into cold water to set the shape. Mixers come in all colors, so you can make a variety of clips to match your best selection of ties.—Donald T. Barry, East Orange, N. J.

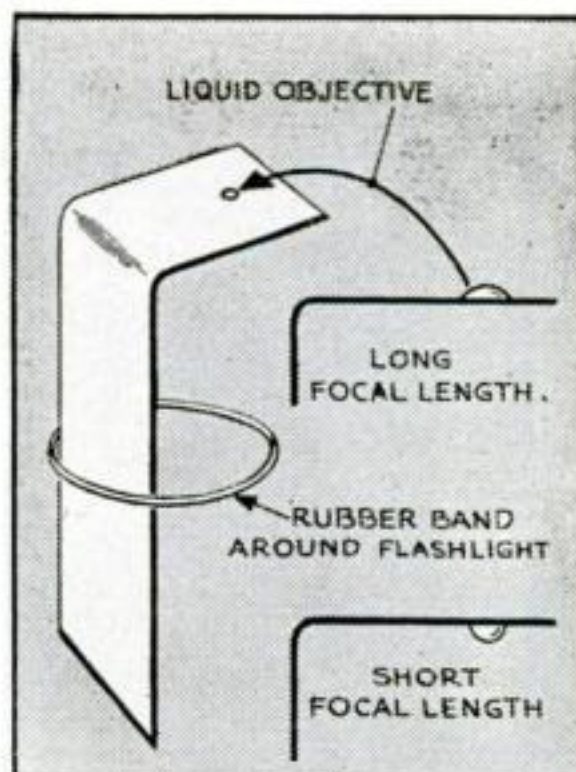


Trailer Coupler Is Removable

ONCE adjusted to any bumper, this trailer hitch may be taken off or put back on again in a few seconds. The Crocket Manufacturing Co., Culver City, Calif., which makes the device, points out that this eliminates the eyesore of driving with a coupler that isn't being used. This model, rated at 2,000-lb. capacity, retails for about \$6.



A drop of oil or water is the magnifier in this instrument.

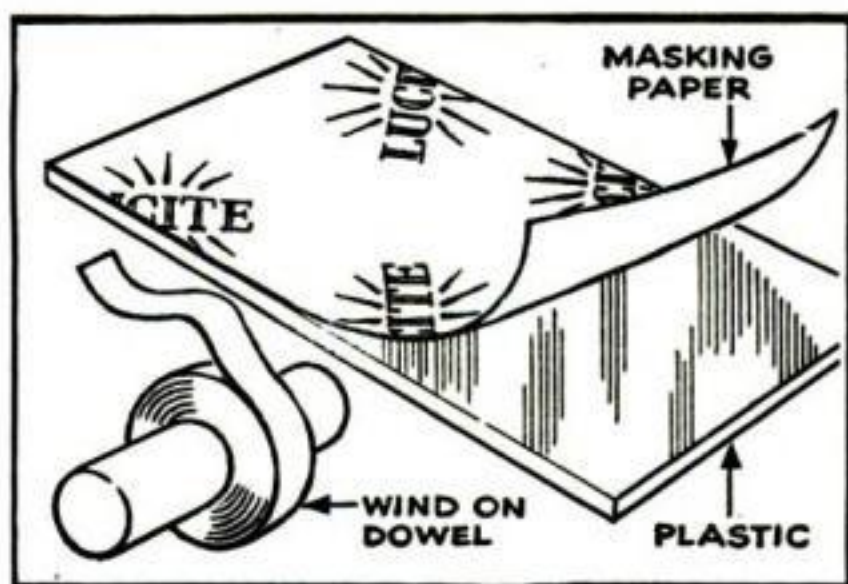


Simple Flashlight Microscope Employs Liquid Lens

ALTHOUGH you can assemble this flashlight microscope in five minutes and at practically no cost, it is as effective as many low-power microscopes now on the market. An ordinary flashlight bulb supplies the illumination, which is quite intense due to the closeness at which it is used. Other parts consist of a thin brass or tin-plate strip, a rubber band, and a drop of refractory liquid for the lens.

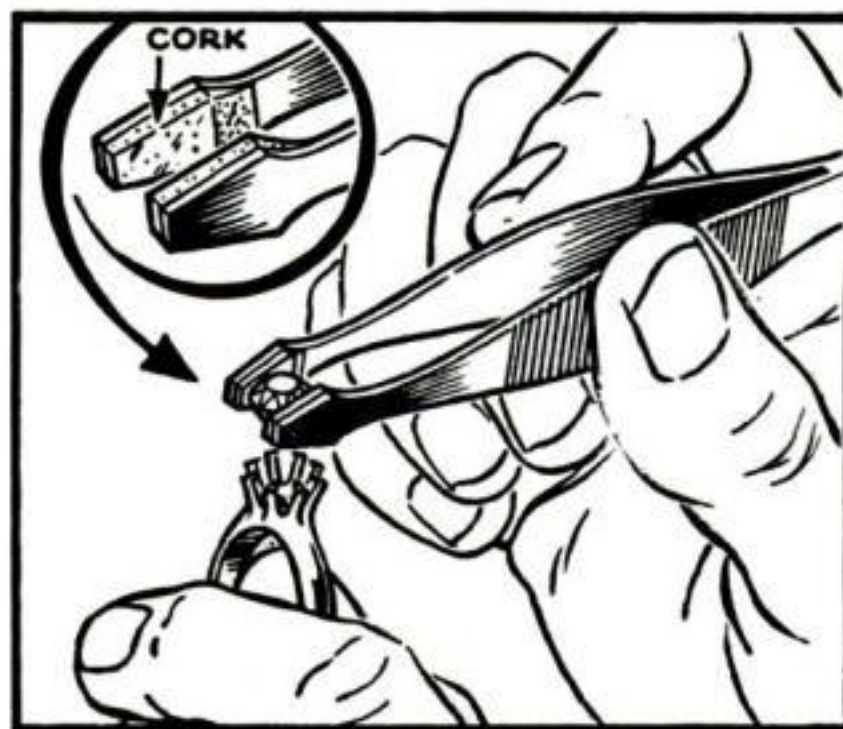
Use a needle to make the lens aperture, removing any burr with a fine file or emery cloth. A large needle will increase image brilliance but reduce definition; experiment with different sizes until you find one that

suits you best. For the liquid lens, a drop of water, glycerine, or white mineral oil can be used. The shape of the droplet determines the power of the lens; a thin drop will have comparatively long focal length, good definition, and medium power. A fat drop will focus closer and have more power. A drop placed above the hole will of course be thinner than one that sags down below it. Focus by gently sliding the metal arm up or down on the flashlight case. Slides under study may be laid directly on the glass. Numerous refinements, such as a stand for the flashlight and a holder for the slides, can be devised.—Ken Murray, Colon, Mich.



Masking Paper Reused as Tape

INSTEAD of throwing away the masking paper peeled off plastic sheet, cut it into strips of any desired width and wind them up on dowels. You'll find that the tape will come in handy in many ways, including masking for painting (especially spraying), wrapping parcels, holding inlay veneers, and stenciling.—Frank Shore, Manhattan, N. Y.



Tweezer Jaws Lined with Cork

CEMENTED and trimmed flush, cork pads on the jaws of a pair of tweezers will reduce the likelihood of scratching jewels, soft optical-glass lenses, and other highly polished or delicate objects.



Bound copies of magazines look neat, take up less space, and preserve the issues longer.

How to Bind Your Favorite Magazine

By J. W. Rocke and M. C. Anderson

QUITE apart from the fact that they look neater and last longer, bound copies of magazines take up less space and can be referred to more easily. Chances are that

if you tackle the job of binding at home, you'll find it less difficult and more interesting than you've suspected.

Each of the main steps is covered in the accompanying photo sequence. For the clamping press, use fairly heavy plywood, $\frac{3}{4}$ " or better. Butcher's cord or other tough twine will do nicely as the sewing thread. The method of sewing, known as the "all along" stitch, consists of drawing the needle in from the center fold of the section at one end notch, around the tape, out at the next notch, along to the next one, and so forth.

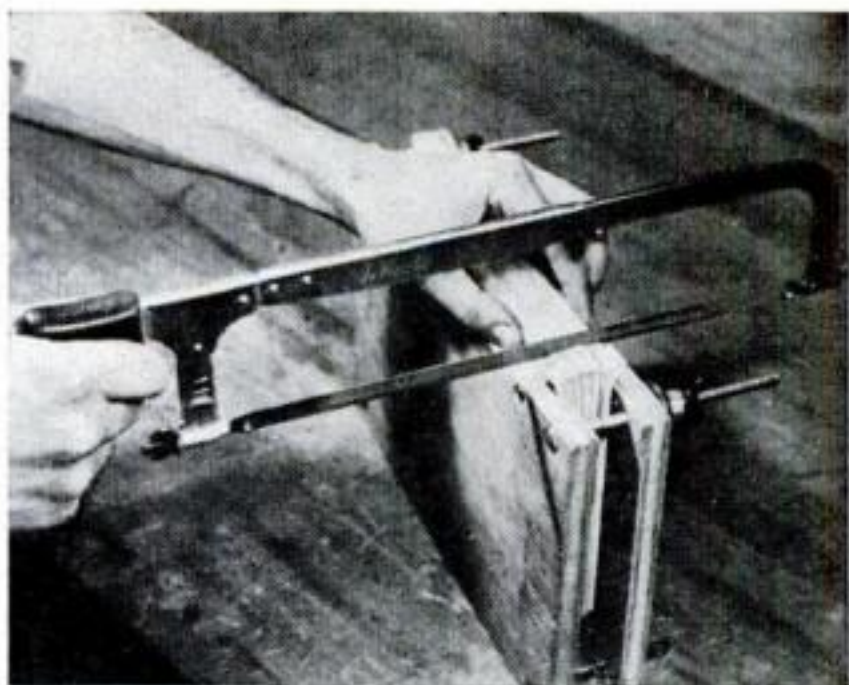
Each section is sewed individually and the kettle stitch is used to tie together the ends of every three sections. The tape to which the sections are sewed should be a stout cloth tape, such as common gummed cloth mending tape. Don't tie the sections too tightly together, or else difficulty will be experienced in shaping the back. The stitch binder can be cut from a piece of muslin, as are the headbands. Each of the latter should be about $1\frac{1}{2}$ " wide and long enough to fit the curved back. Fold them around pieces of heavy cord.



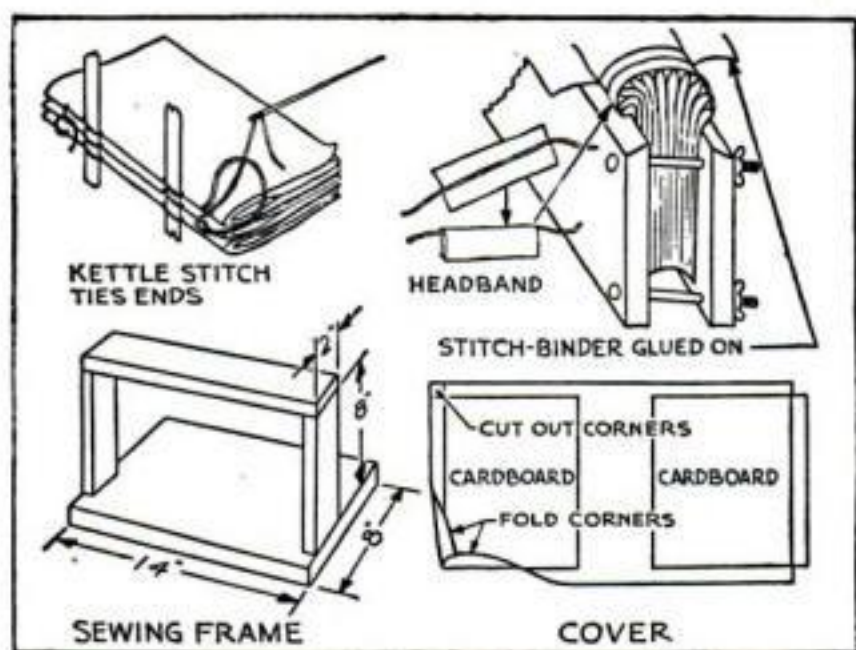
Materials for binding are generally available and aren't expensive. Rubber cement gives a quick, firm bond without warping the paper. A trip to the scrapbox will probably provide the materials for the press and sewing frame.



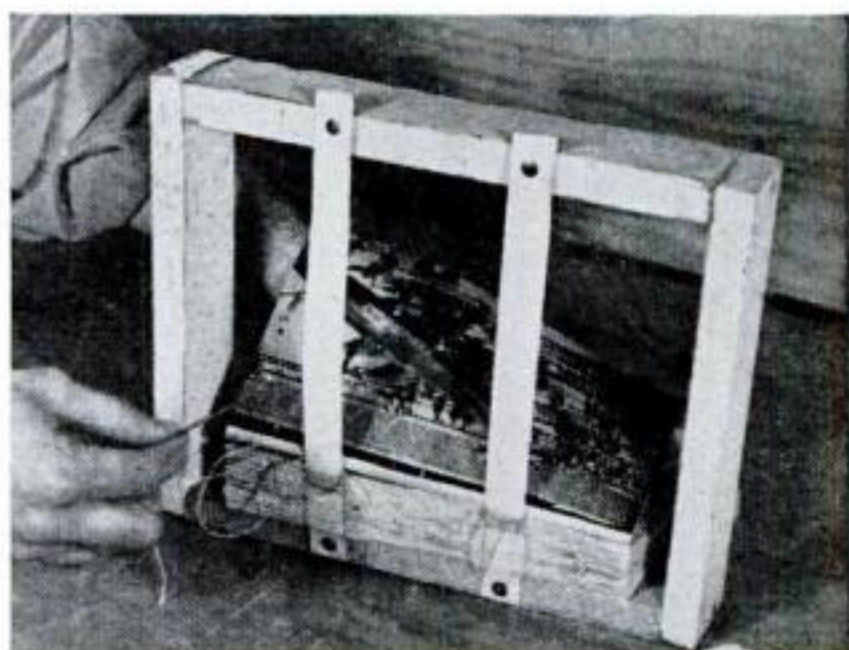
1. Tear off the cover, remove the staples, and loosen the glued sections by repeated rubbing with a wet rag. While advertisement sections may be discarded if you wish, save the cover and index pages. Keep the sections in order.



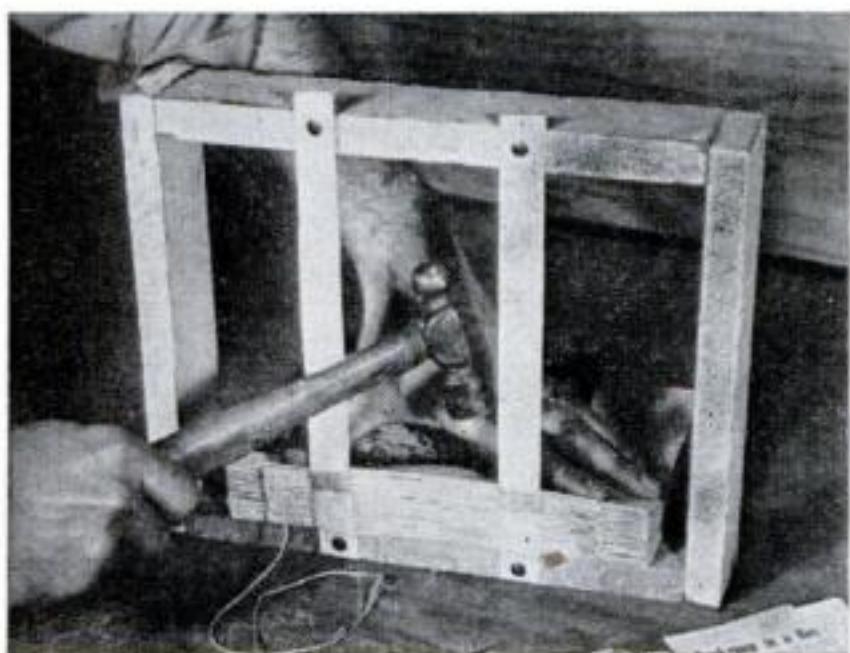
2. Clamp sections to be bound in the press, measure in 1" from each end, and make two hacksaw cuts about 1/16" deep. Measure in from each the width of the tape you will use, and make two more similar saw cuts at each end.



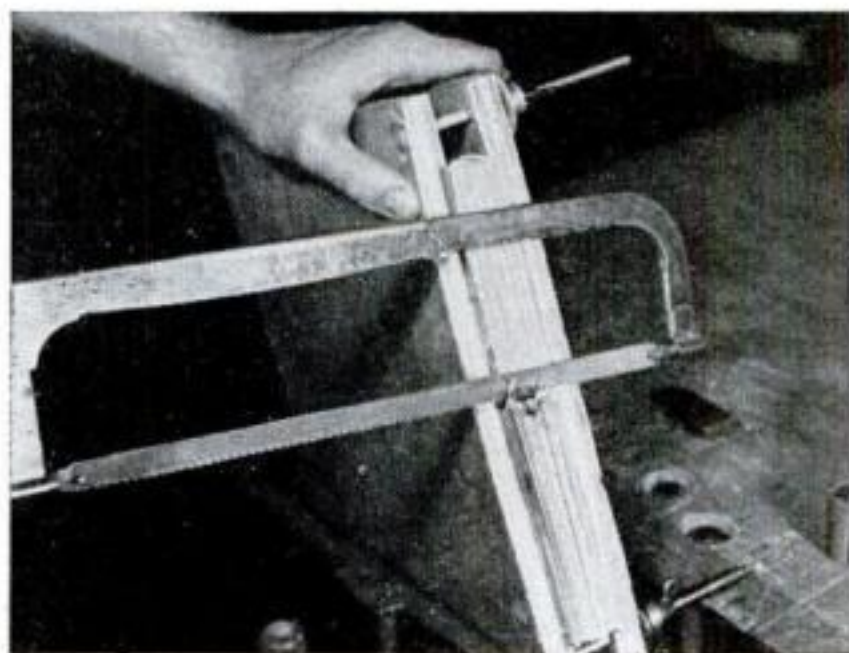
3. Dimensions of the sewing frame aren't important so long as it's bigger than the magazine to be bound. Note the details of the kettle stitch that locks the sewing thread, the headband, stitch binder, and cover.



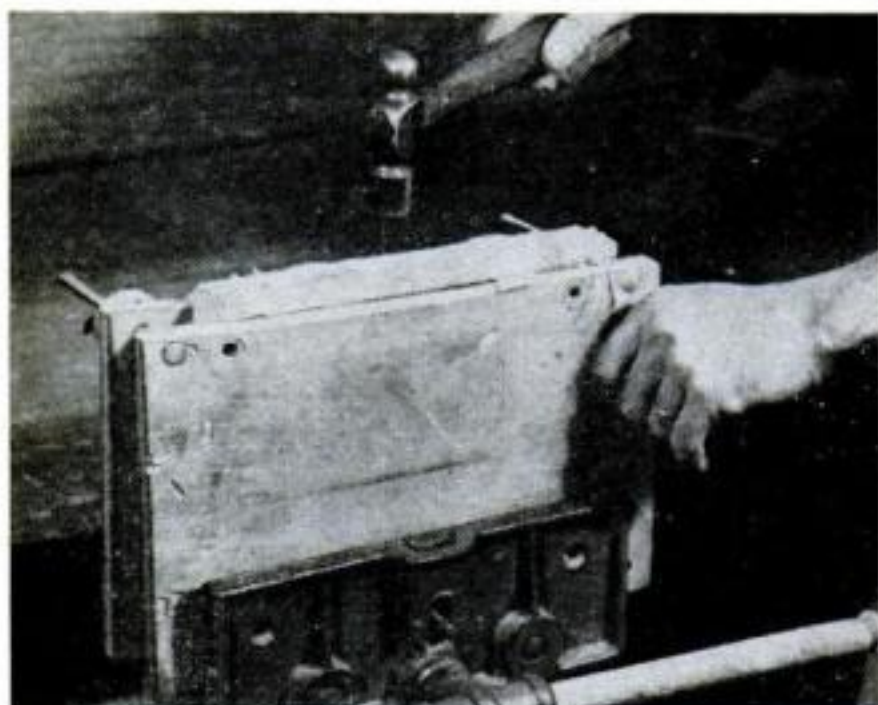
4. Tack tapes to the frame according to the spacing of the saw cuts. Place the sections nearby, and insert in the frame first the one that's to be last in the book. Open to the center and stitch through with butcher's cord.



5. The needle goes in at the end, around the tape, in again, and along. Tie the cord ends with kettle stitch every three sections. If you pound the sections down lightly as you go, the back will not become too bulky.



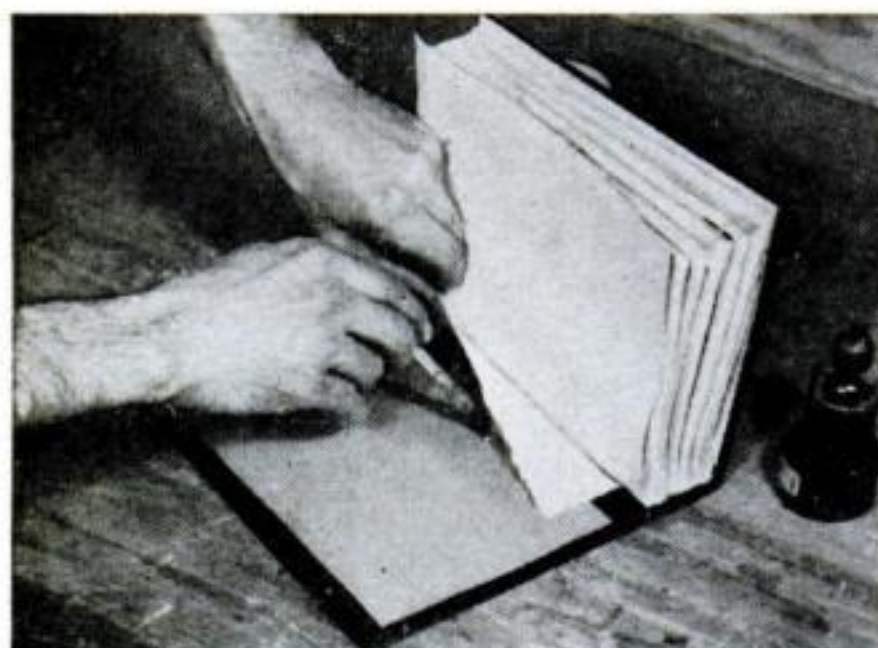
6. Trim the edges after sewing, first clamping the sections tightly. Use a hacksaw and cut in far enough to remove all irregularity. Then sand with medium grit paper to remove saw marks. A wood chisel will also trim it.



7. Shape the back to a rounded form with the clamp frame loose, tighten it with about $\frac{3}{4}$ " projecting, hammer to form the outer sections over the frame, coat well with glue, and press on the stitch binder and the two headbands.



8. For the cover, cement cardboards the size of the page to leatherette or fabric. Allow a space equal to the width of the back plus 1" between the cardboards. Also cement on a paper stiffener that's the width of the back.



9. Center the book in the cover after the glue has dried, and glue the stitch binder to the cover, using wax paper to keep the binder from sticking to the outer pages. Let it dry under pressure with the book closed.



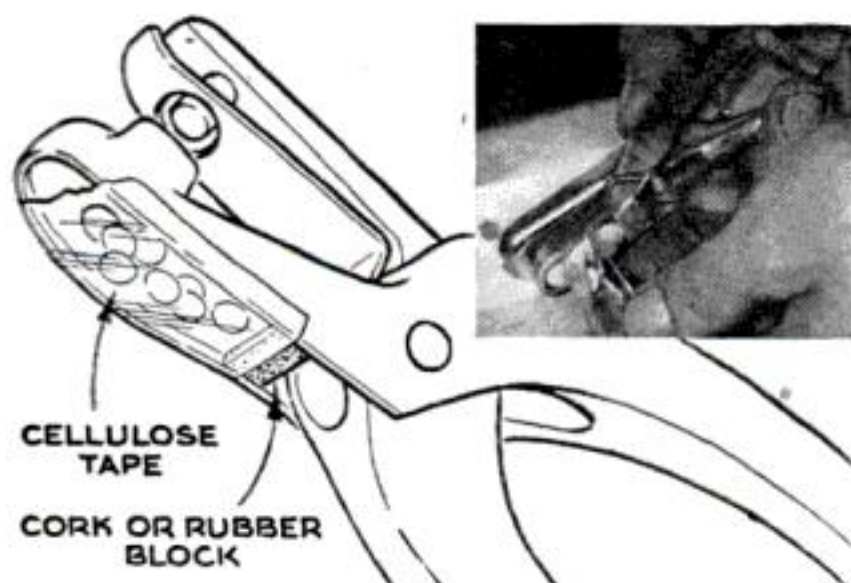
10. A cover sheet cemented inside each cover hides both the stitch binder and the lapped corners of the cover material. Either white or colored paper of a good grade should be used, with rubber cement rather than glue.



11. Flyleaves, two in front and one in back, give a finished touch to the job. Trim to the same size as the book page plus a $\frac{1}{4}$ " gluing flap. Magazine contents pages may be cemented to the front flyleaves if you prefer.

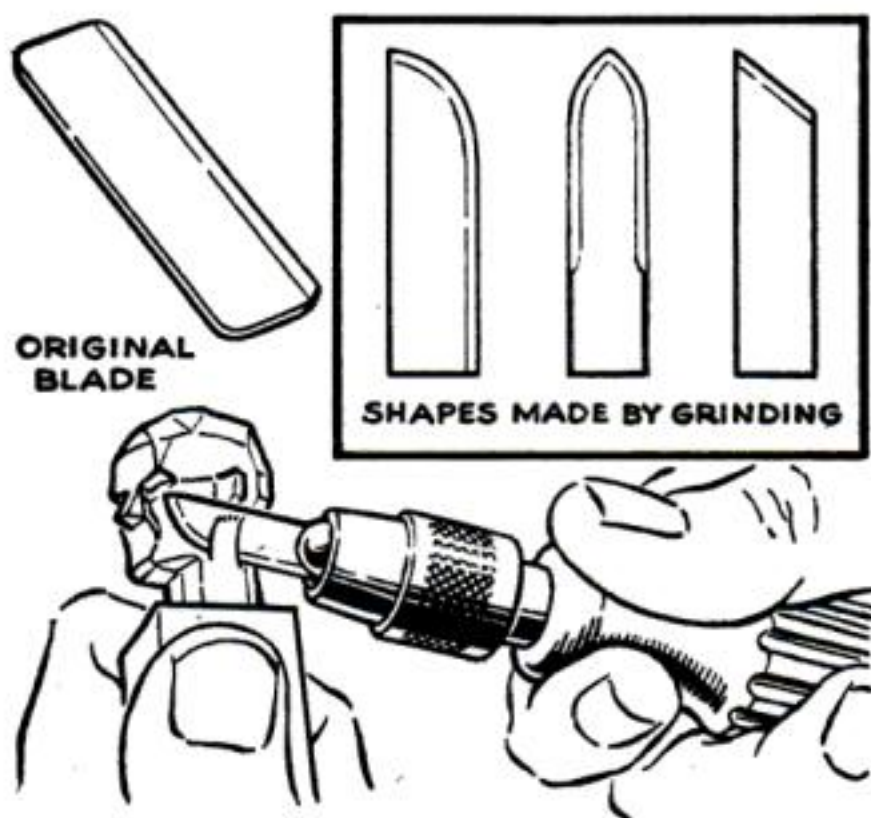


12. Titling of the bound volumes can be done with ink or paint, but an attractive cover is obtained if you simply cement on one of the torn-off covers to the front, while the title from another is cemented on the back. **END**



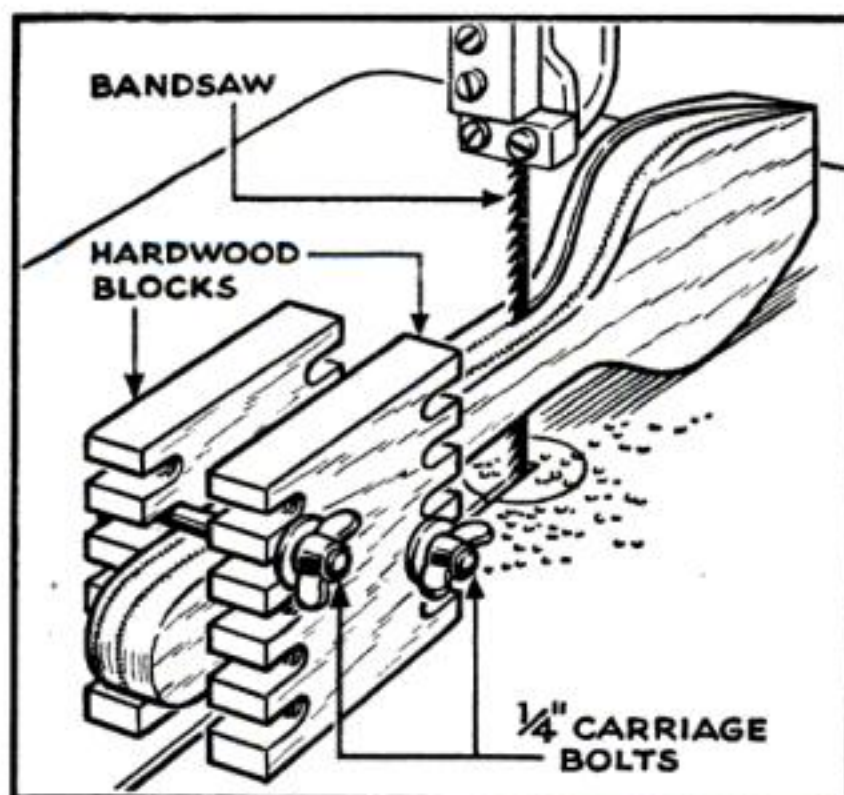
Tape Holds Punch Confetti

THE nuisance of picking up elusive little paper punchings can be eliminated, even if your punch is not the type that has a built-in "reservoir", by means of a tape receptacle like that shown above. Wedge in a small block cut from an eraser or cork, trim it off flush, and then press on a length of cellulose tape over the hollow portion of the punch. Since the tape is transparent, you can easily see when the chamber has filled with punchings. To empty it, simply peel off the tape, shake out the waste, and apply a new piece of tape to replace the one removed.—*Andrew Vena, Philadelphia.*



Razor Blades Used in Knife

EXCELLENT replacement blades for chuck carving tools can be had by grinding old razor blades of the kind used in injector-type razors. Grind on a fine wheel (being careful not to overheat the blade and draw the temper), and then hone on a fine stone. Blades can be ground to a variety of special-purpose shapes to suit particular jobs.—*Raymond F. Ball, Utica, N. Y.*

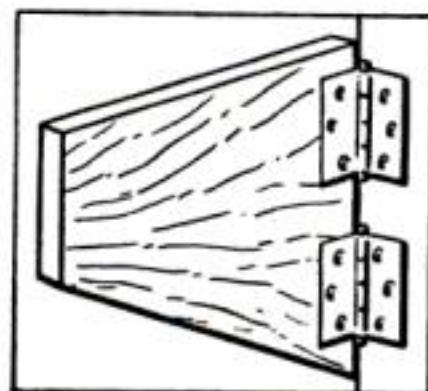
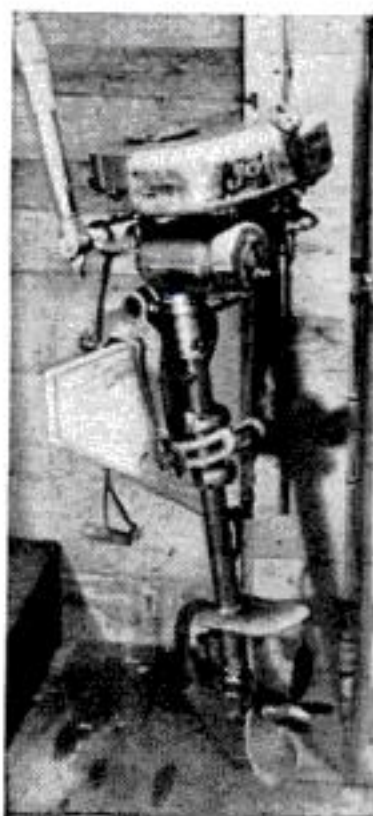


Holder Aids in Sawing Curves

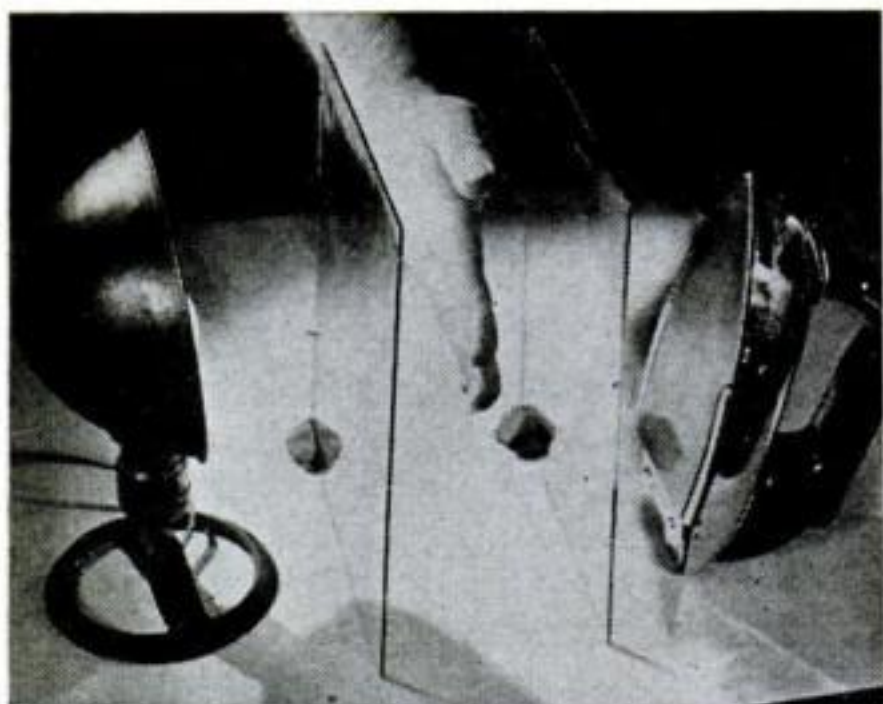
WHEN sawing compound curves on a bandsaw or jigsaw, it's common practice to tack the waste back on to get a flat surface on the table for subsequent cuts. The extra effort this involves as well as the risk of damaging a saw blade on the nails or brads that hold the waste can be avoided if you make yourself a holding jig like that above. Its disadvantage is that the work must be reclamped when you saw up to the jig, but this can be done quickly. Drill holes near the edges of two hardwood blocks, open them out into slots, and assemble with bolts, washers, and wing nuts.—*Ralph S. Wilkes, Keuka Park, N. Y.*

Hinged Rack Supports Motor

STOWAGE of a small outboard in a locker crowded with other gear is simplified with this hinged rack of stout wood. When I lift it off the boat, I just clamp it to the rack and then swing it back into a less accessible part of the locker. Use plywood if possible — *Kenneth Buckley, Poulsbo, Wash.*



Radiant Heat Packs a Punch

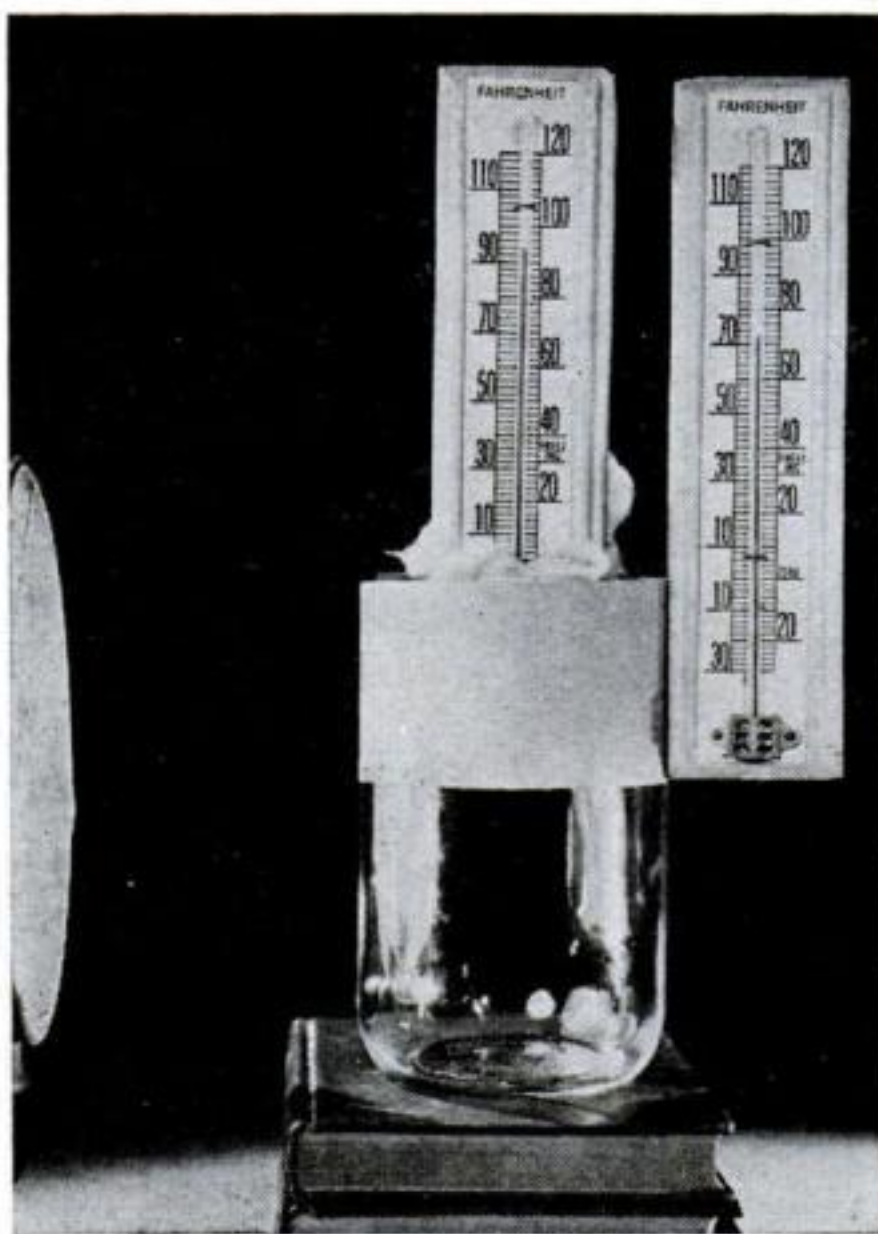


It Passes Through Glass. Short heat waves radiated from the sun, electric lights, and other high-temperature sources pass readily through glass, but the longer waves from radiators, electric irons, and other bodies that are not so highly heated do so only with difficulty. This may be demonstrated by setting up two similar sheets of glass, an electric iron, and an electric lamp as above. If you place your hand between the sheets of glass, the side toward the lamp will feel much warmer.

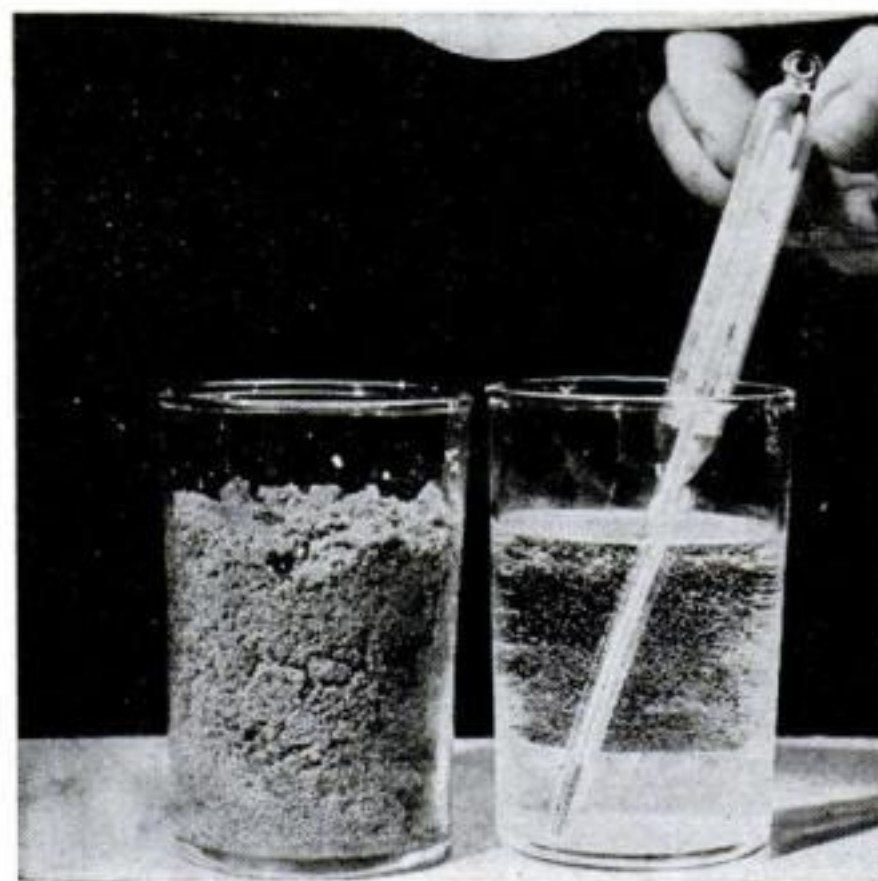
Lakes Affect Climate. The fact that radiant heat penetrates deeper into water than it does into soil and rock helps explain why the climate changes less near large bodies of water.

Radiation from the sun is stopped at the soil surface and is changed into heat. Consequently, the surface layers of the earth become quite hot. At night, this heat is lost rapidly. On the other hand, sun radiations heat water to some depth, but nowhere does it become as hot as surface soil. After sundown, water retains heat better.

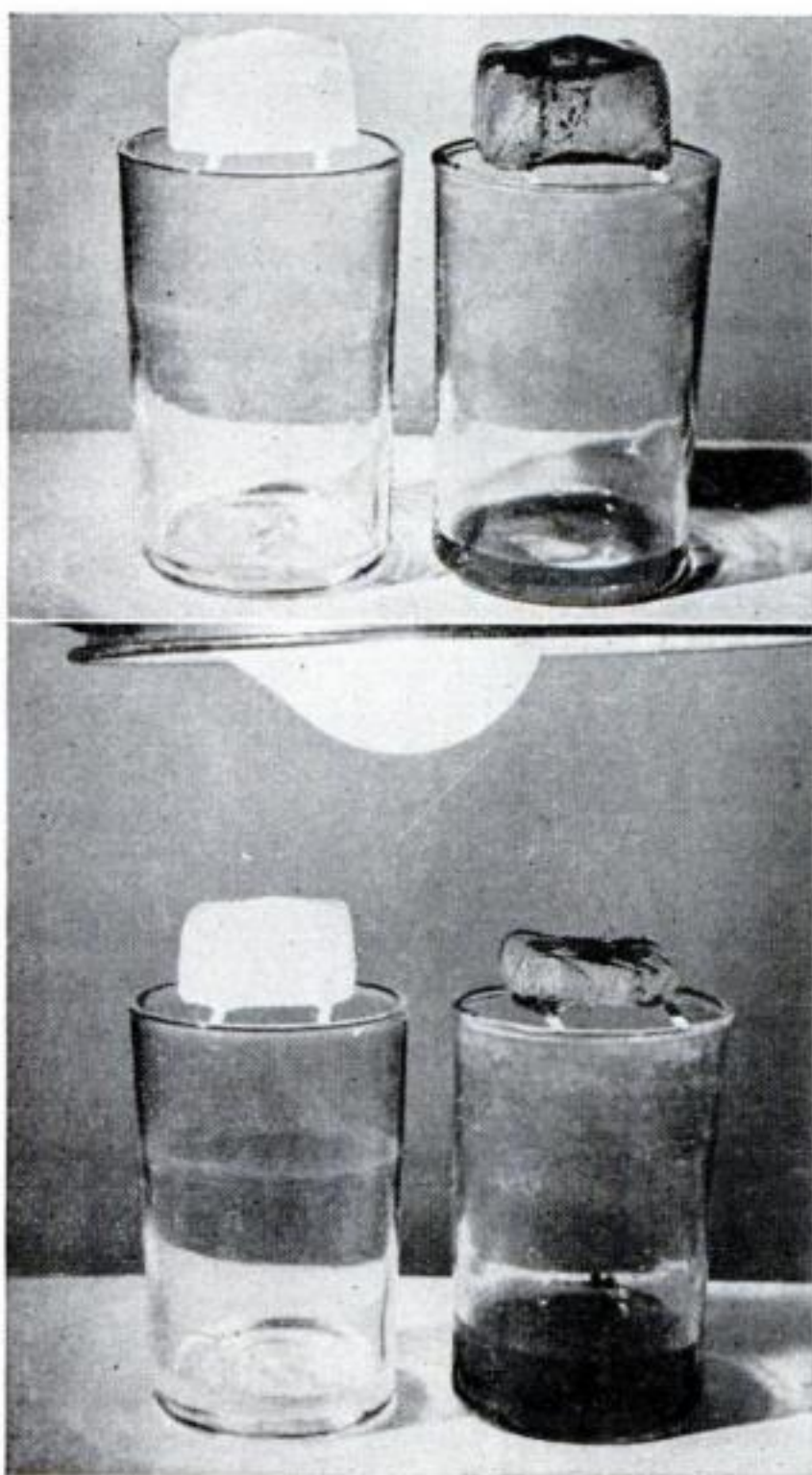
This may be shown by placing a tumbler of soil and another of water under the rays of a lamp for several minutes. Test the soil and water and note that the surface soil gets hotter but water holds heat longer.



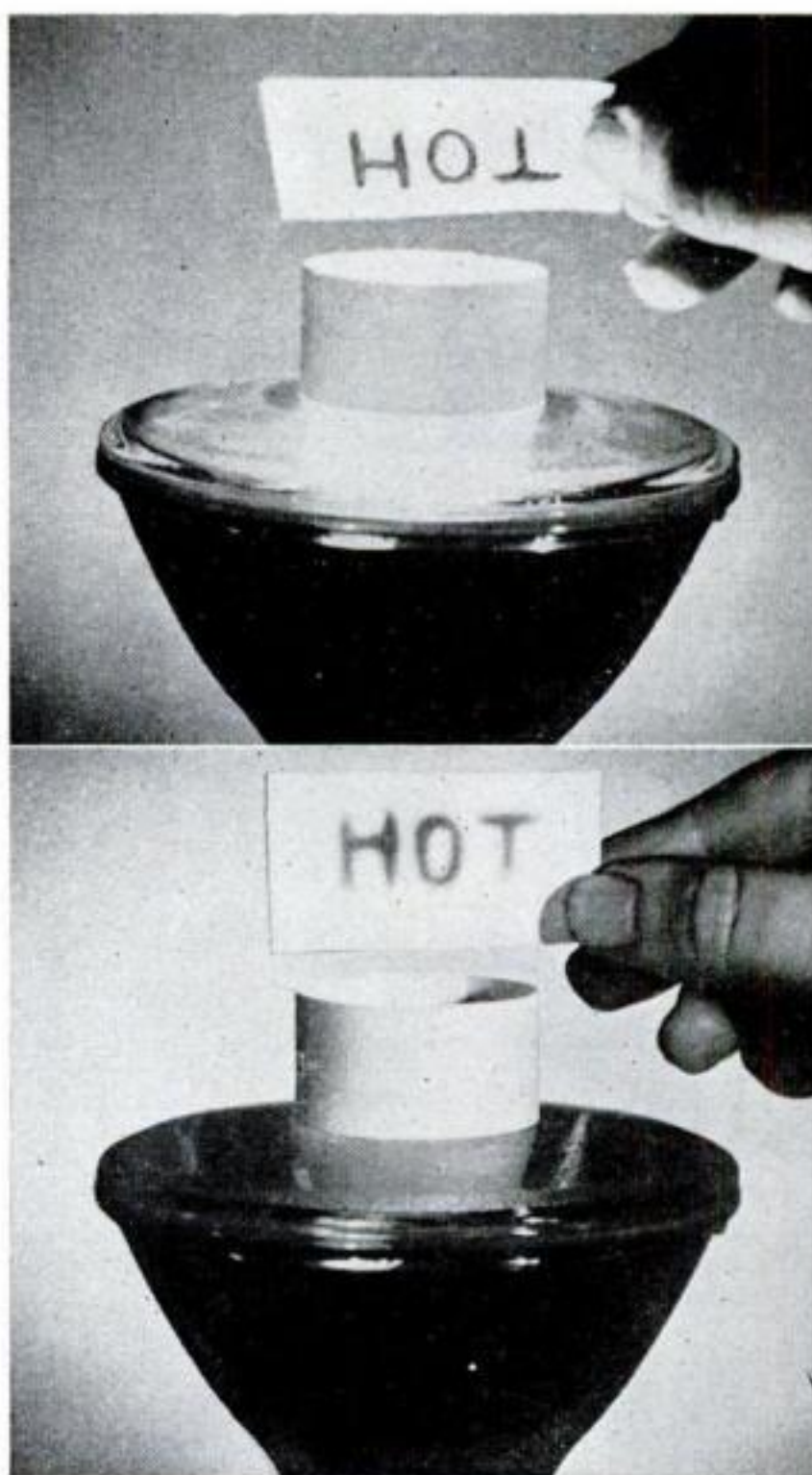
Glass Traps Long Waves. In homes and greenhouses, solar warmth is trapped inside by a curious one-way characteristic of glass. The short heat waves of sunlight enter and heat the air inside. But the air is heated to a comparatively low temperature and its longer heat waves can't escape out through the glass. Seal a thermometer in a jar with cotton, protect it from direct light by paper, and face a lamp toward it. The air inside will soon become much warmer than that outside.



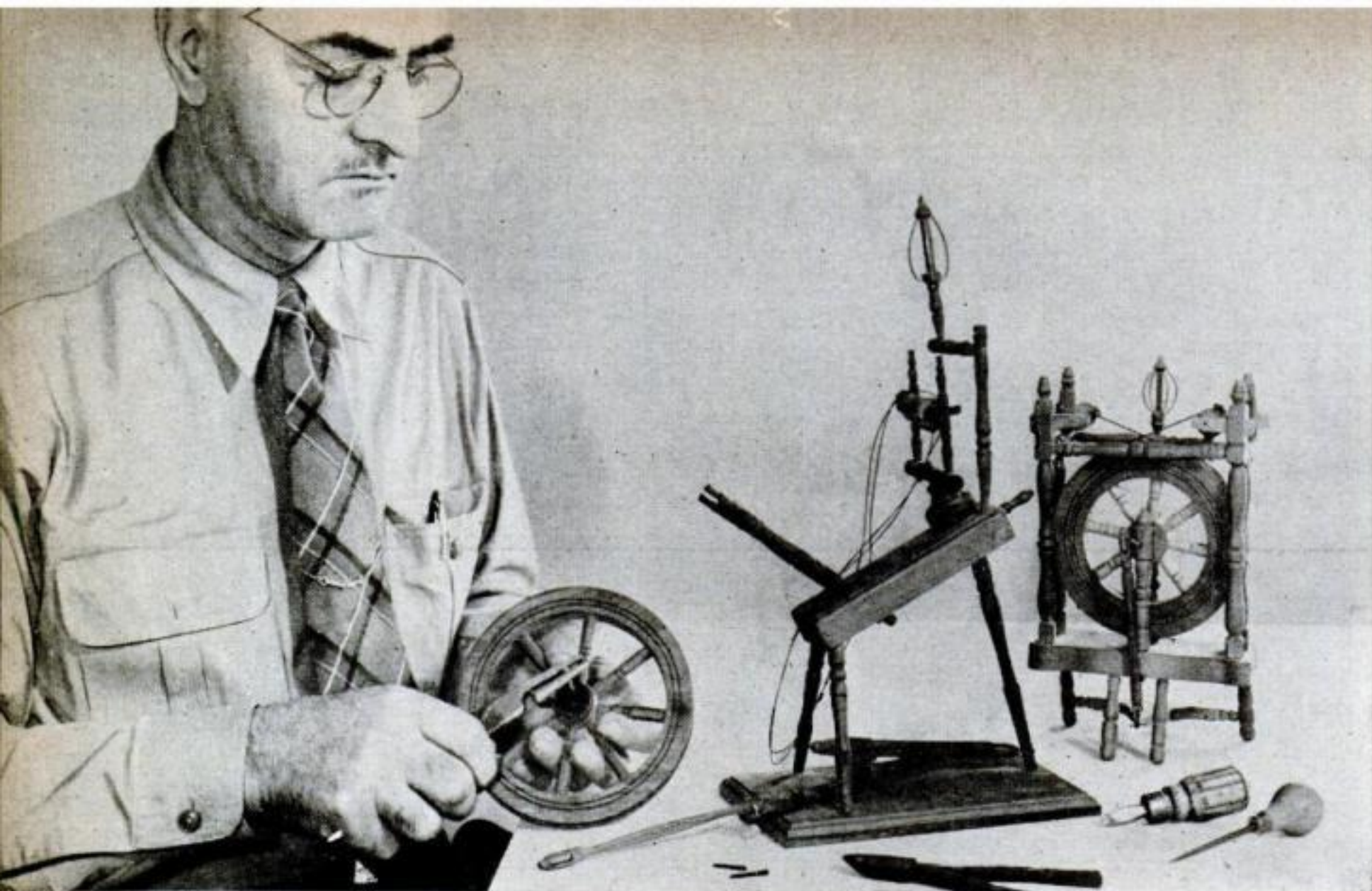
Air Thermometer Responds Quickly. With a bottle and glass tube you can make a thermometer that will react quickly to heat radiations. Smoke the surface of the bottle thoroughly in a candle flame, push the tube through a one-hole stopper, and support the bottle so the tube dips into colored water. If the bottle has just been smoked, it will still be warm. As it cools, the air inside will contract, drawing colored water part way up the tube. To cause the thermometer to register the effect of heat radiations, hold a lamp a foot or two from it. The water will drop quickly. Hold a book in front of the lamp, and the water will rise again.



Dirty Ice Melts Faster. Because dark rough substances absorb radiant heat much faster than those that are light in color and smooth, dirty snow and ice melt rapidly when exposed to an electric light or to the sun's rays. This may be shown by supporting two ice cubes, one of them soot covered, on toothpicks over two tumblers. At ordinary room temperature, the melting will be about equal. But if an electric light is placed above the two, you soon will have the result seen in the bottom photo.

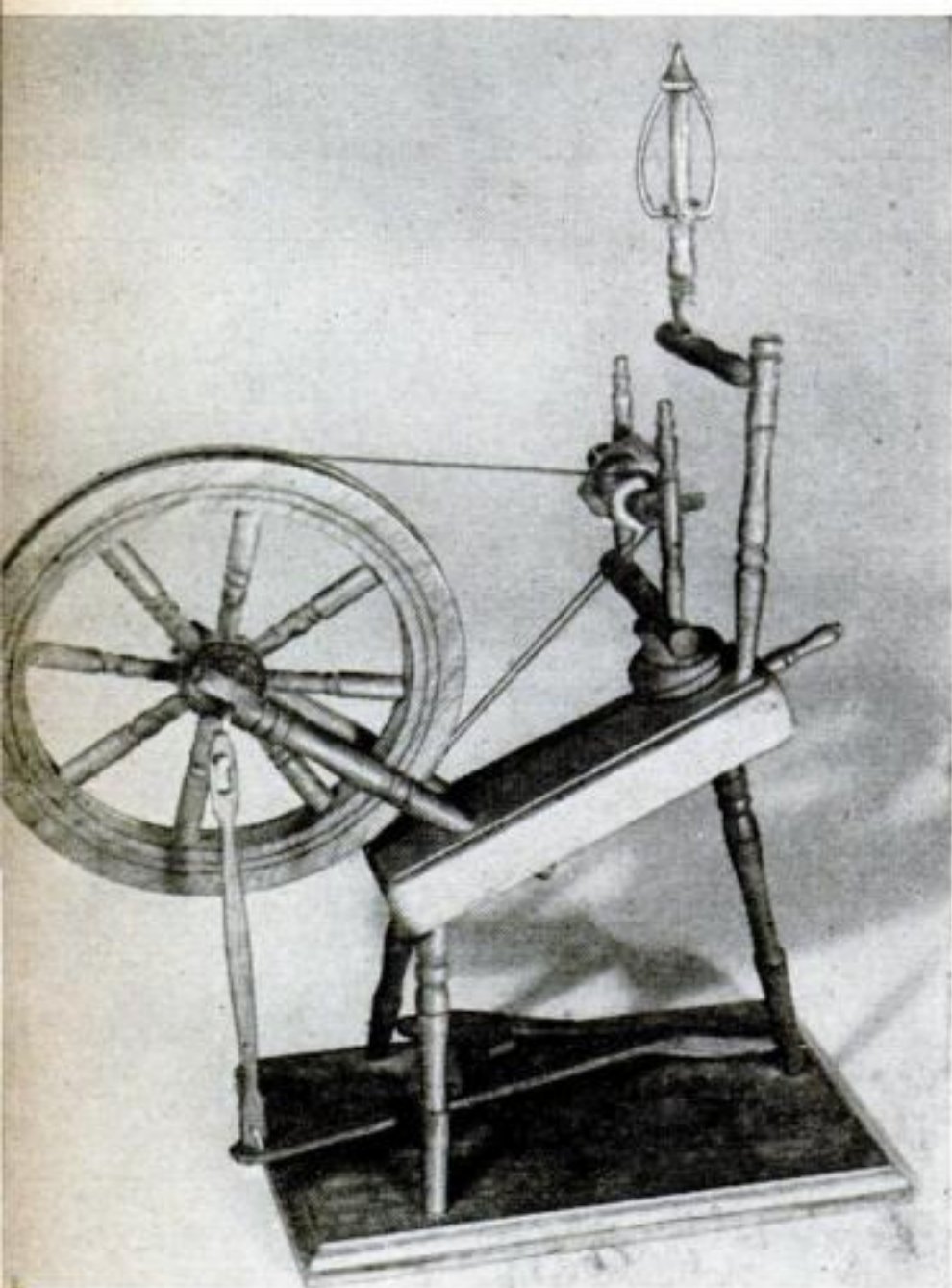


Lettering Burns Through. The difference in the rate of radiant-heat absorption between black and light objects can be shown by writing a word with India ink on a sheet of paper. (The stunt is more dramatic if you print each letter upside down, as at the top.) When the ink is dry, support the lettering face down on a reflector spot lamp. Within a few minutes, the lettering will come through on the other side, the paper having charred because of the great absorption of the black ink.



Treadle, pitman, and crank work just as in the full-size spinning wheels E. J. Waltner uses

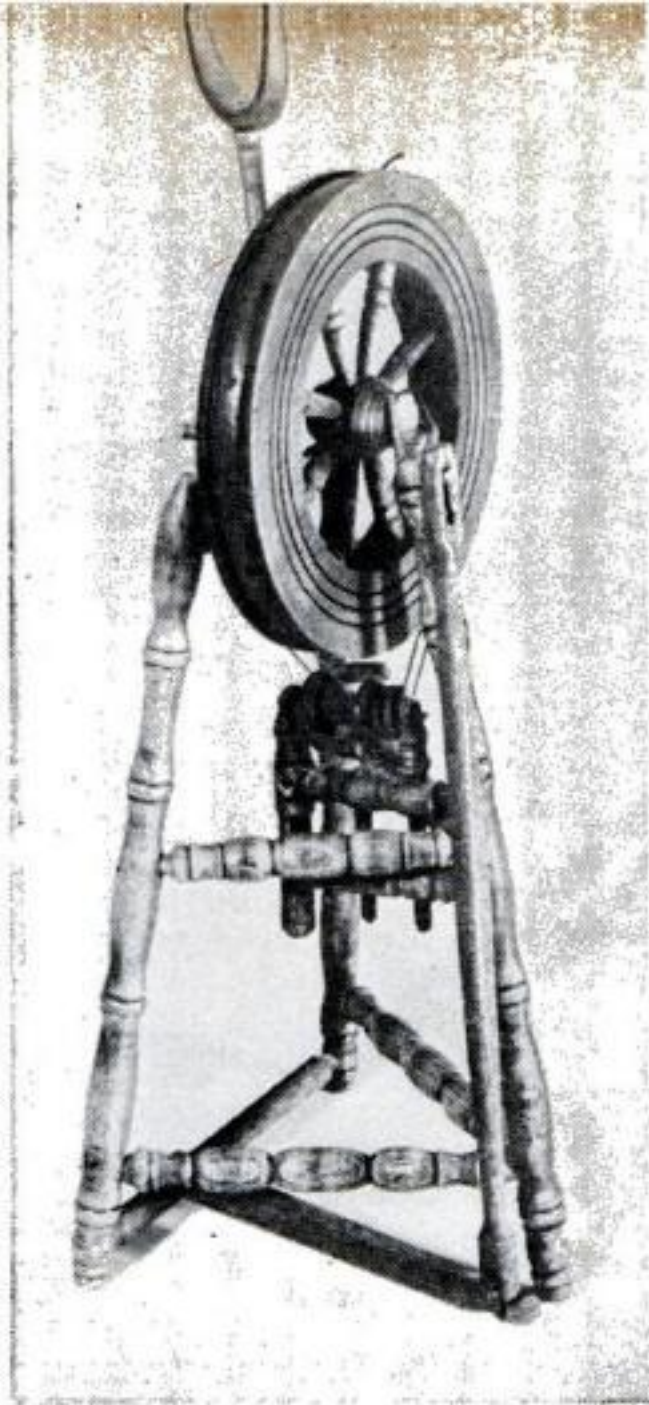
as his prototypes. At right is a Dutch wheel, unusual for having twin fliers instead of one.



Ready for a spin, this model of a Russian flax wheel was scaled down from one discovered in a cobwebby attic. The original traveled to the prairies with immigrants who became pioneers.

Model Wheels Spin Yarns of Pioneer Days

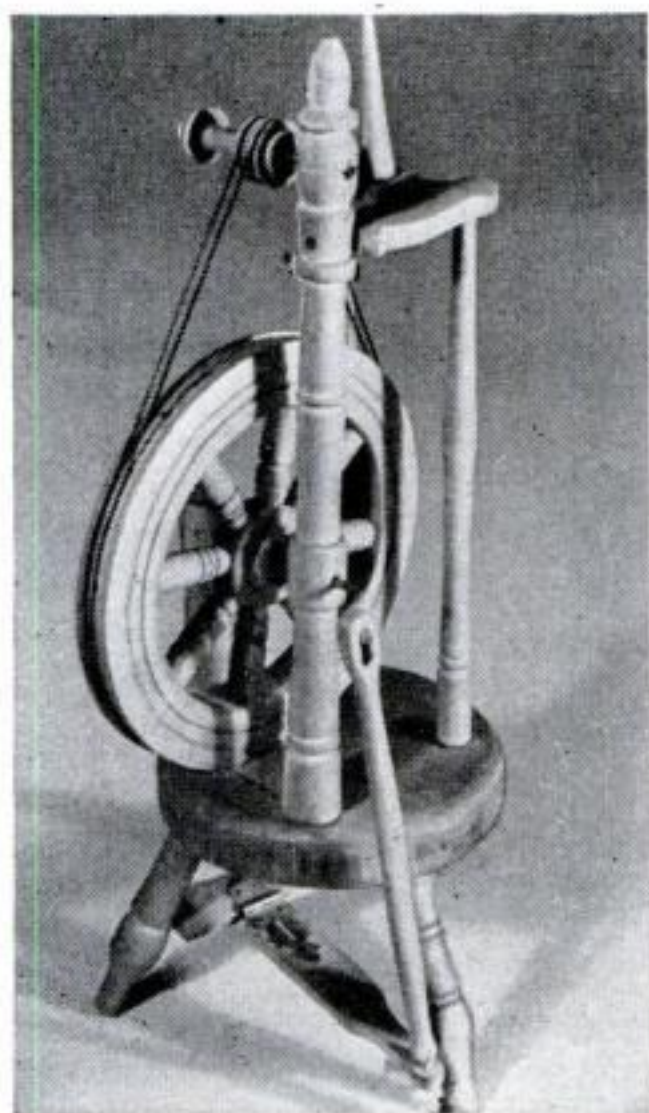
IF Tom Thumb had a wife, she could spin yarn for family clothes on these tiny spinning wheels, for they're realistic working models right down to the distaff. Making them is the hobby of E. J. Waltner, of Hurley, S. Dak. A descendant of the pioneers who settled the Dakota prairies, he first saw such a wheel at work under his grandmother's fingers. These photos show models of the old wheels he has found in museums, attics, and barns. Though all work on the same principle, their details are as different as their origins. The models are all built to scale, legs and wheel spokes being lathe-turned like those of their prototypes.



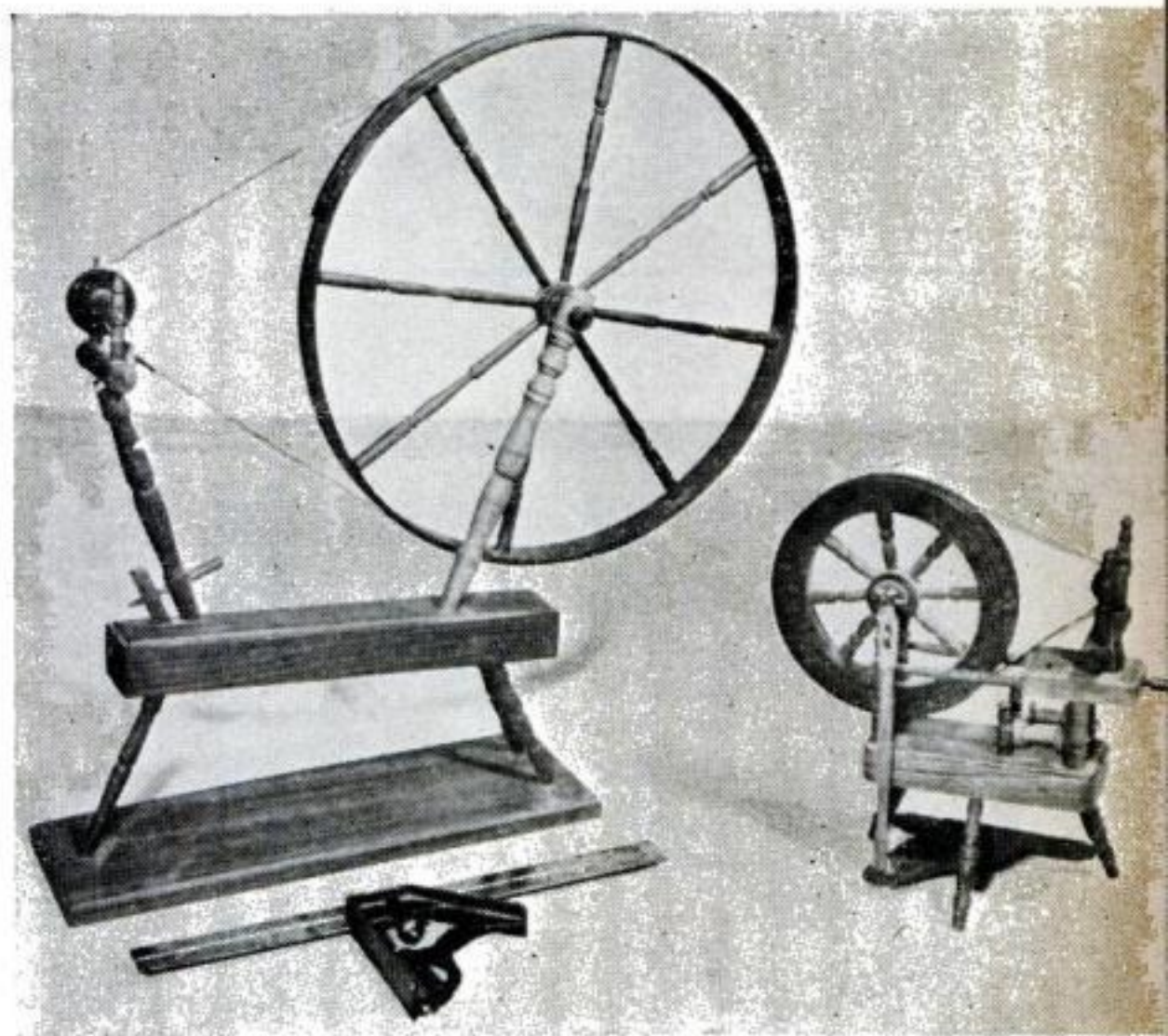
Irish eyes smiled over wheels of this kind. The flier, which twists the yarn, and the spool that reels it up are set below.



And still they spin. Even today, women of the Hutterian Brethren, a group who settled in South Dakota in 1874 to escape persecution abroad, make spinning wheels whirl. Raw wool is spun, and the yarn washed until snow white.



The Czechoslovaks had a word for it, but the wheel was much the same. The spool was set high. A simple wood spike held the wool.



Pilgrim fathers let the ladies stand. Their wheel, the big one at left, had no treadle and was run by striking the spokes with a stick. The Swedish wheel at the right, modeled to the same scale, was run by a foot treadle.

Use Those Extra Asbestos Shingles

Who ever heard of the shingling job that ended in a perfect tie between the number bought and the number needed? Whether you like it or not, part of that last bundle will be left over. But you certainly ought to like it, because left-over shingles—both asbestos and asphalt—have countless uses around the house. A few are illustrated here, and you will think of others. Both types are good for friction uses, but stick to asbestos for jobs that call for heat resistance.—*B. Halpern, Jackson Heights, N. Y.*



Prevent slipping by nailing strips to ladder rungs or to worn cellar steps. Lessen the danger of electric shock through a damp floor by laying a shingle platform near the fuse box.



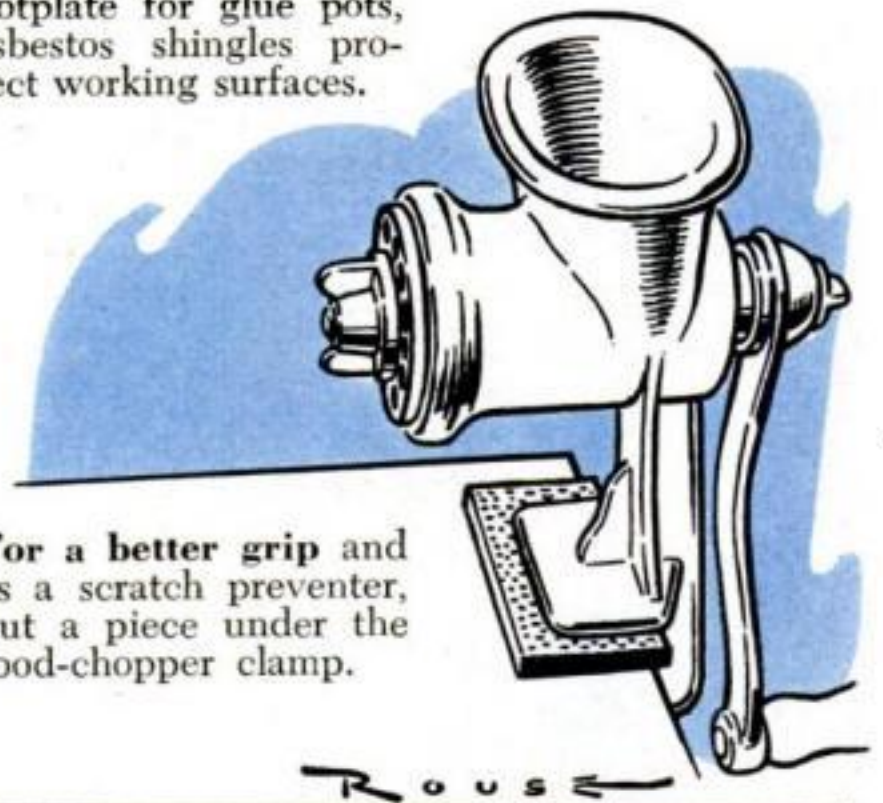
Deaden the noise and vibration of a typewriter and keep the machine from crawling by putting it on a shingle. Use another under the phone, especially a dial type, which tends to slip.



Under an iron, or as a hotplate for glue pots, asbestos shingles protect working surfaces.



Protect walls and floors with asbestos sheets when soldering or using a torch on a pipe. If you use a torch to remove old paint, protect the surrounding wall area with the shingles.



For a better grip and as a scratch preventer, put a piece under the food-chopper clamp.



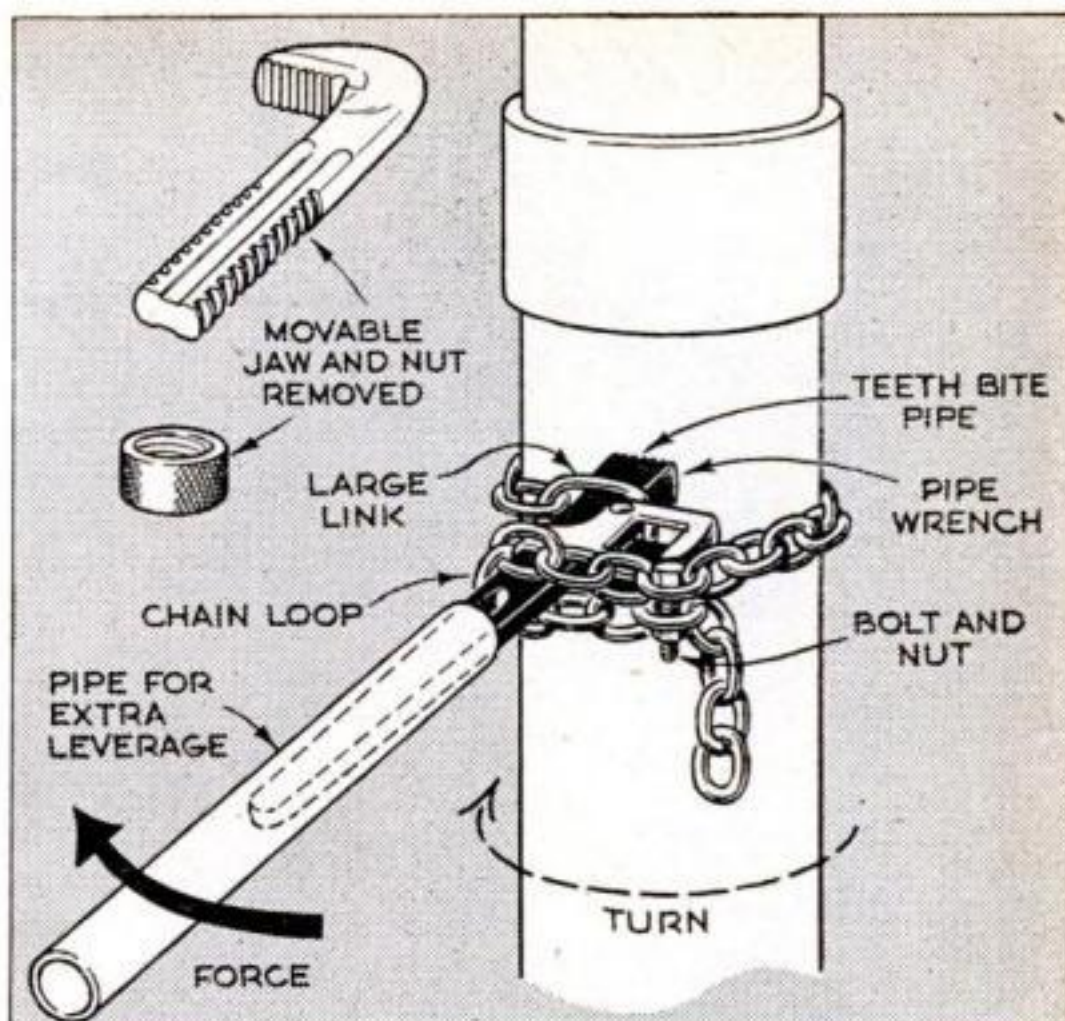
Rest a hot soldering iron on asbestos shingle and stop worrying about scorching the bench. You can even do your soldering right on the pad; it won't draw heat away from the work.



Remove the nut and jaw of a big pipe wrench to use it as a chain wrench.



Loop a sturdy chain around the pipe and fasten it as shown at the right.



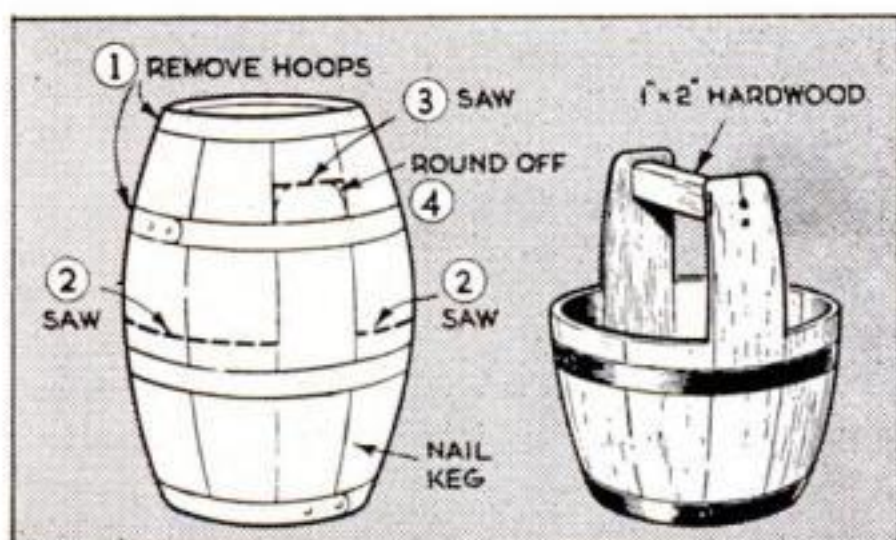
Chain on Pipe Wrench Grips Large Diameters

WHEN you have to turn an out-size piece of pipe and have no wrench that will make it, use the largest one you can find and improvise the rest with a length of sturdy chain.

One end of the chain should have a link large enough to fit over the fixed jaw of the wrench. Take off the nut and movable jaw, and pass the chain around the pipe. The large end link is then hooked

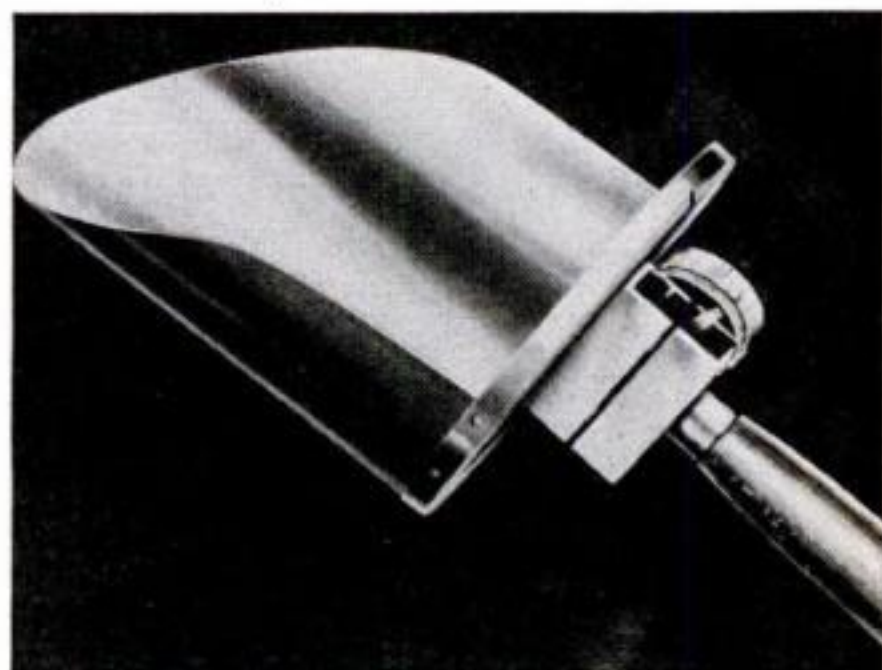
onto the remaining jaw and the other end of the chain is looped and bolted around the wrench handle as shown in the drawing. If the chain is too loose, make it shorter by twisting.

Applying pressure on the wrench handle makes the jaw bite in and assures a firm grip even when the pipe turns. A small piece of pipe slipped over the handle will furnish extra leverage.—*Andrew Vena, Philadelphia.*



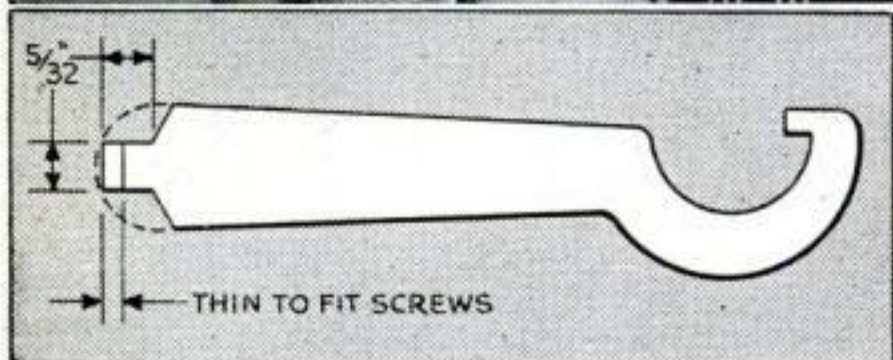
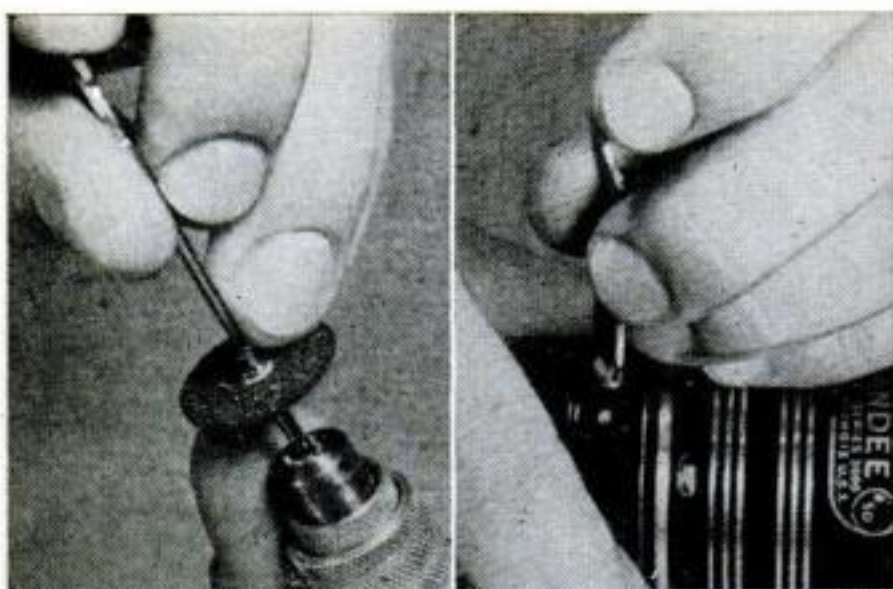
Nail Keg Converted to Bucket

A HANDY bucket for a variety of uses can be made from an empty nail keg. Slip the two upper hoops off the keg and cut the staves as shown in the drawing. A dowel or a piece of 1" by 2" hardwood, fastened between the two tall staves, serves as a handle. Such a bucket is especially useful for carrying plumbers' fittings and tools. It's strong and makes less noise than a metal one.—*Arthur Trauffer, Council Bluffs, Ia.*



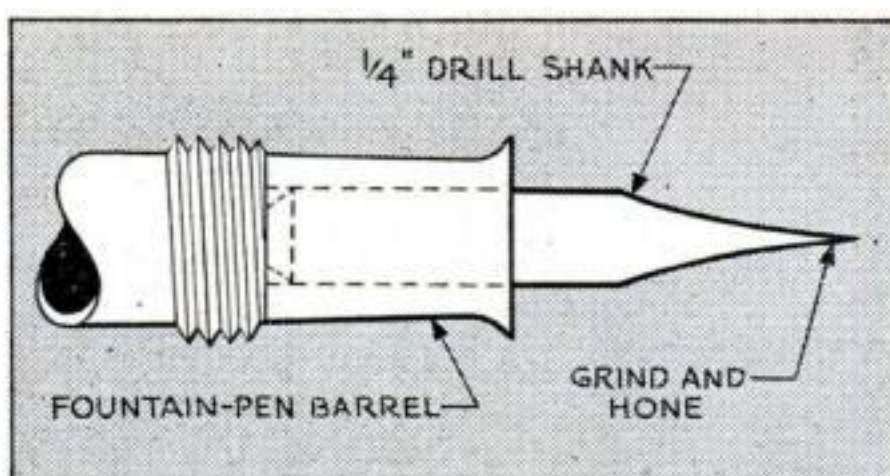
New Scoop Has Built-In Scale

THIS new scoop weighs feed as it shovels it out and indicates poundage on a dial in front of the handle. Called the Dollydale Scoop-Scale, it will hold four pounds and is rust and corrosion resistant. It is made by the Robson Corp., New York, and costs about \$7.50.



Wrench Ground as Screwdriver

Two extra uses can be built into the chuck wrench or spanner that's usually provided with a hand grinder or motor tool. By grinding the end of the wrench down to the dimensions shown, it will serve both as a fine screwdriver for the frequently removed screw at the end of a mandrel, and as a huskier screwdriver for the slotted oiling plug on the grinder body. The wrench is not needed for its original purpose while the mandrel screw is tightened or loosened, since the position of the protective sleeve locks the chuck. Don't thin the small blade more than necessary or it may bend in use.—*Jack Wilson, San Pedro, Calif.*



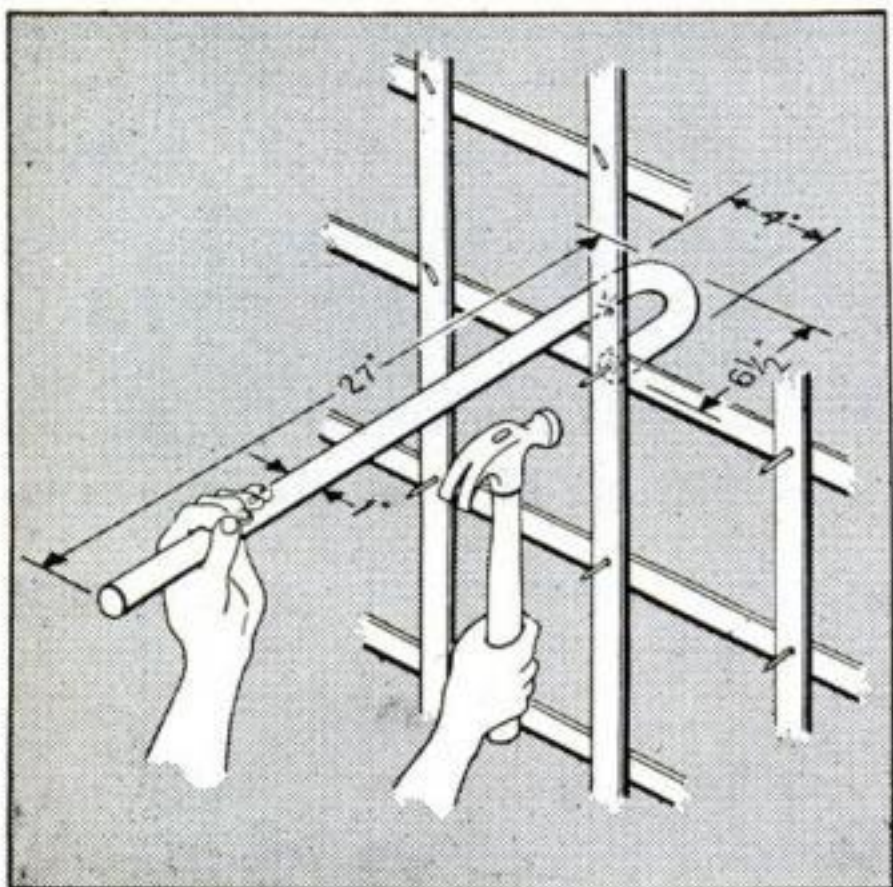
Old Pen Converted to Scriber

WORKING in an aircraft plant calls for plenty of layout scribing, but I find most scribes too thin to permit constant handling without tiring the fingers. I removed the point from an old fountain pen, and pressed in the pointed shank of a broken high-speed-steel drill. An easy way to develop the point is to chuck the shank in an electric drill and hold it against an emery wheel, after which it is polished with emery cloth and honed with a fine India stone. The fountain-pen cap protects the point and makes it safer if you carry it around in your pocket.—*J. G. Martin, Milford, Conn.*

Buffing Sharpens Small Tools

CARVING chisels and gouges, especially small ones, can be made extremely sharp if you first work them on a fine stone and then buff on a cloth wheel charged with tripoli or rouge. Stop when a little "feather" forms on the cutting edge; it will disappear the moment you start to carve.—*Herbert R. Pfister, Bronx, N. Y.*

Hooked Steel Rod Serves as Handy Bucking Bar



FACED with the job of building a 100' lattice fence 6 1/2" high, I was puzzled as to how I could nail and clinch the 2,500-odd unsupported junction points without a helper to buck from the other side. The bent steel rod pictured at the left proved to be the answer. Using the hook extended through the lattice to brace it, I drove the nails in from one side, first making sure they'd clear the rod. Then I moved to the other side and used it as illustrated to clinch them.

Although 3' of 1" steel rod may seem a bit too heavy at first, I find it desirable because 1" face area is large enough to prevent marring of the wood, and because the weight is sufficient to prevent rebound.—*John F. Ewing, Hollywood, Calif.*



... and Oil Pumping is the First Symptom

It's possible to ignore oil pumping for a while, and to continue buying and wasting oil. But this kind of neglect is bound to cost *real* money later because oil pumping and engine wear go hand in hand.

Destructive engine wear is not far off when oil pumping starts.

By installing Hastings Steel-Vent Piston Rings promptly you can *check* this engine wear, *stop* oil pumping and *restore* performance. It's the best money you can spend on your car. Hastings Manufacturing Co., Hastings, Michigan. Hastings Ltd., Toronto.



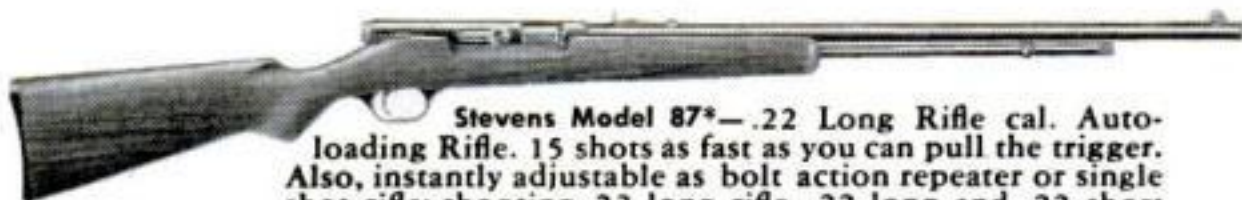
HASTINGS

STEEL-VENT PISTON RINGS

TOUGH on Oil Pumping
GENTLE on Cylinder Walls



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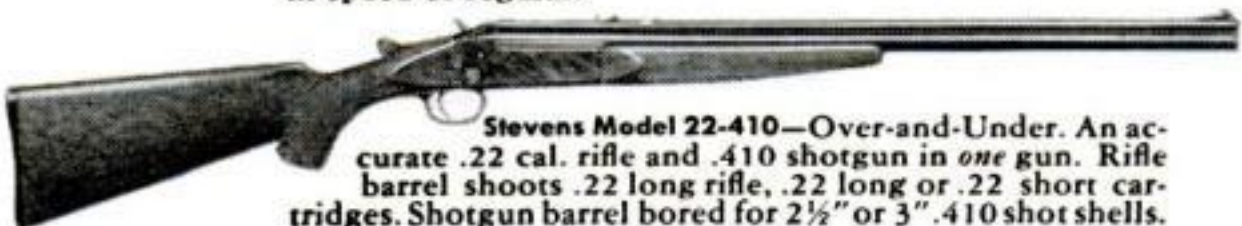
Stevens Model 87*— .22 Long Rifle cal. Auto-loading Rifle. 15 shots as fast as you can pull the trigger. Also, instantly adjustable as bolt action repeater or single shot rifle; shooting .22 long rifle, .22 long and .22 short cartridges.



Stevens Model 84*— .22 cal. Bolt Action Repeating Rifle. 5 shot clip magazine. Full pistol grip. Stock designed for steady holding. Shoots .22 long rifle, .22 long and .22 short cartridges.



Stevens Model 15— .22 cal. Single Shot Bolt Action Rifle — barrel bored and rifled with the same precision which characterizes all Stevens-Savage rifle barrels. Shoots .22 long rifle, .22 long and .22 short cartridges, hi-speed or regular.



Stevens Model 22-410—Over-and-Under. An accurate .22 cal. rifle and .410 shotgun in *one* gun. Rifle barrel shoots .22 long rifle, .22 long or .22 short cartridges. Shotgun barrel bored for 2½" or 3" .410 shot shells.



Stevens Model 59— Tubular Magazine Bolt Action, .410 Gauge Repeating Shotgun. 5 shot (3" shells), four in magazine, one in chamber. 6 shot (2½" shells), five in magazine, one in chamber.



***New Peep Sight**— Now these Stevens .22 caliber rifles are available, at slight extra cost, with a new, specially designed peep sight with elevation and graduated click windage adjustment.

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For The New Shooter

The safe and accurate handling of firearms is an American tradition. It's worth perpetuating and you can help by starting the young or new shooter off right. For advice and special literature on setting up a program, write: Sporting Arms and Ammunition Manufacturers' Institute, Dept. 4, New York 16, N.Y.



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HUNT 'BUGS' AND...



IF YOUR CAR FEELS LIKE THIS...
IT'S TIME FOR MARFAK
CHASSIS LUBRICATION



THAT CUSHIONY FEELING LASTS LONGER WITH MARFAK!

When you get a lubrication job, get a *good* one. Ordinary grease peters out after a couple of hundred miles. But *Marfak* Chassis Lubrication lasts 1,000 miles and more. *Marfak* takes road shocks with ease, clings to wear points and bearings. And notice that long-lasting "cushiony" riding ease! That's *proof* that *Marfak* is on the job. Applied by chart, never by chance. Ask your Texaco Dealer, the best friend your car ever had, for *Marfak* Lubrication.



THE TEXAS COMPANY

TEXACO DEALERS IN ALL 48 STATES

Tune in: TEXACO STAR THEATER presents the TONY MARTIN show featuring ALAN YOUNG every Wednesday night. See newspaper for time and station.

APRIL 1948 243

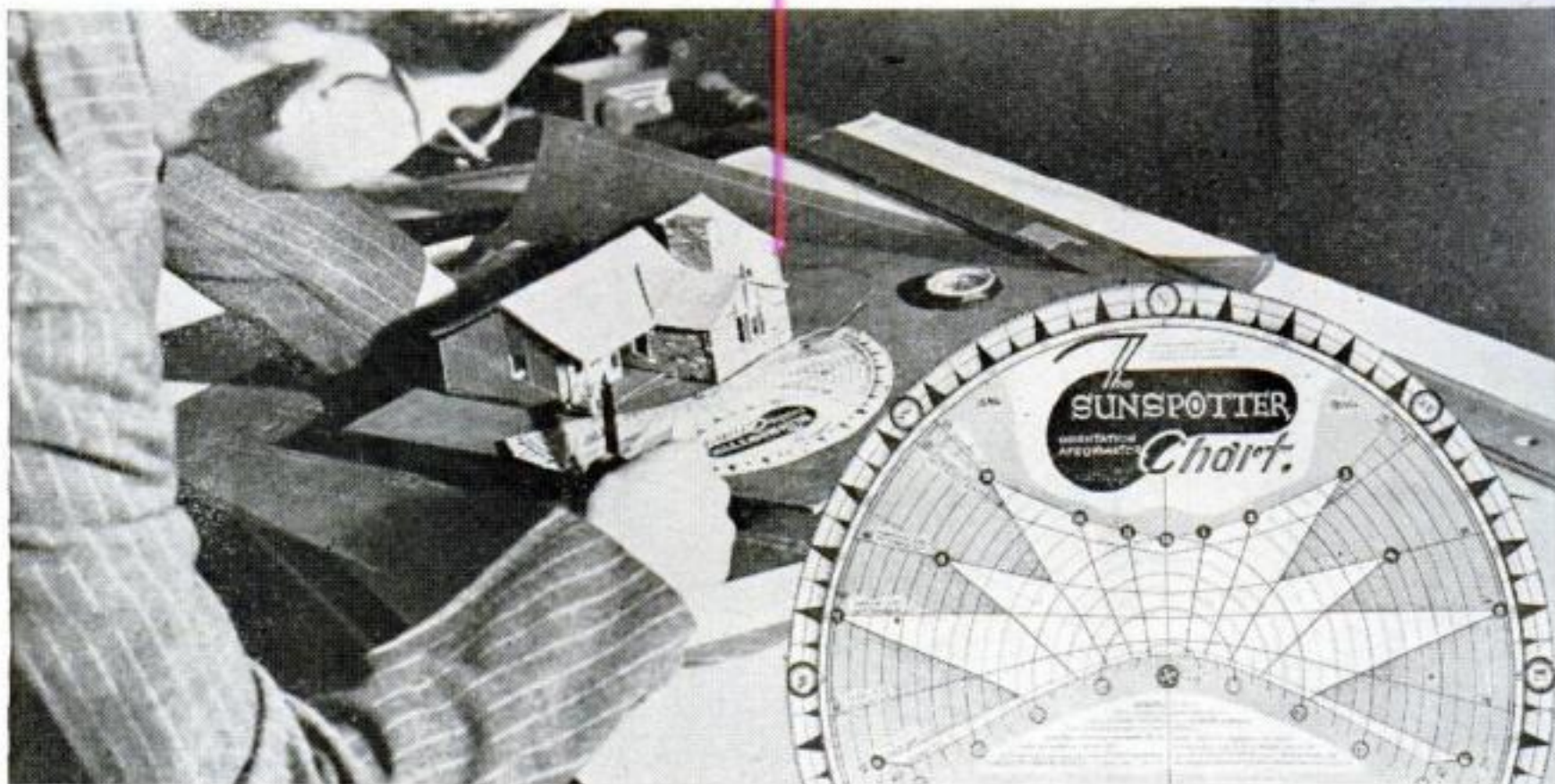
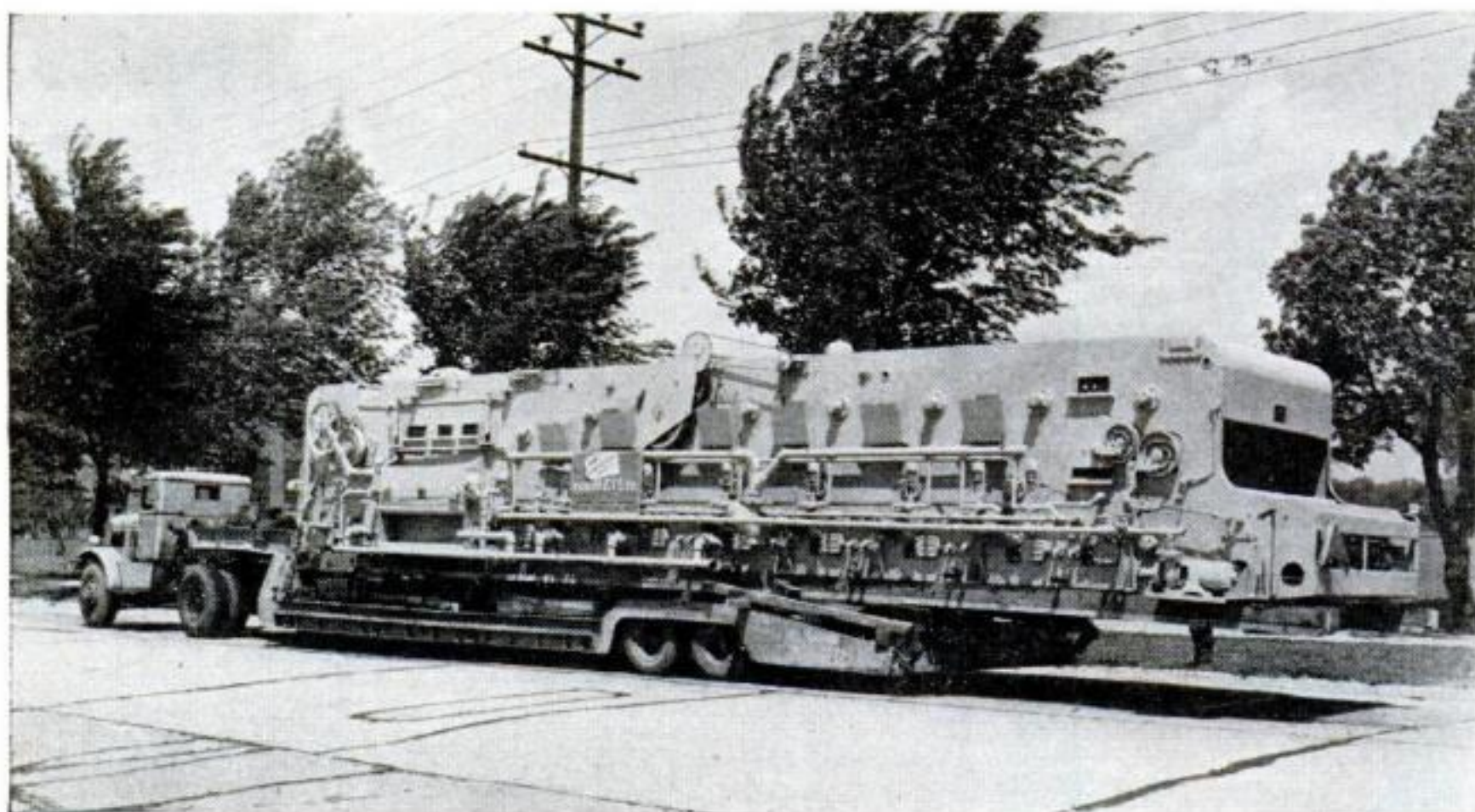


Chart Plots Sunlight

ORIENTATION—planning the position of a building in terms of a desired relation with the sun—can be an architectural headache. To simplify the job, William Briggs, an industrial designer, developed a two-dimensional Sunspotter Chart that helps an architect determine—without time-consum-

ing observations—how much sunlight will enter a particular room during any hour of any day in the year. By interpreting solar angles and indicating the depth to which sunlight will penetrate an interior, the chart provides answers that, according to Briggs, would otherwise require as much as two whole days of complex plotting and figuring for even a six-room house.



Biggest Bottle-Washer

THIS 65-ton mass of machinery is probably the world's largest automatic bottle-washer. Built by the Heil Co., of Milwaukee, the \$35,000 unit can clean 280 bottles a minute, holding 12,768 at a time.

The bottles are sterilized by water jets and caustic solutions at temperatures up to 180° F. for 30 minutes. Shown above en route to the John Graf bottling company, whose building had to be reinforced to support it, the 48-foot-long, 11-foot-wide giant will weigh 100 tons when fully equipped.

NOW... LIGHT WHEN YOU NEED IT!

Ray-O-Vac LEAK PROOF batteries
stay fresh for years!

(because they're sealed in steel!)



Guarantee: If your flashlight is damaged by corrosion, leakage, or swelling of this battery, send it to us with the batteries and we will give you FREE a new comparable flashlight with batteries.

©1948 BY RAY-O-VAC COMPANY, MADISON, WIS., RAY-O-VAC (LIMITED) CANADA, WINNIPEG, MAN.



Man! Oh, man! It sure is dandy
Always having *fresh* spares handy!

Sealed in steel to keep their power,
So you can use them any hour.

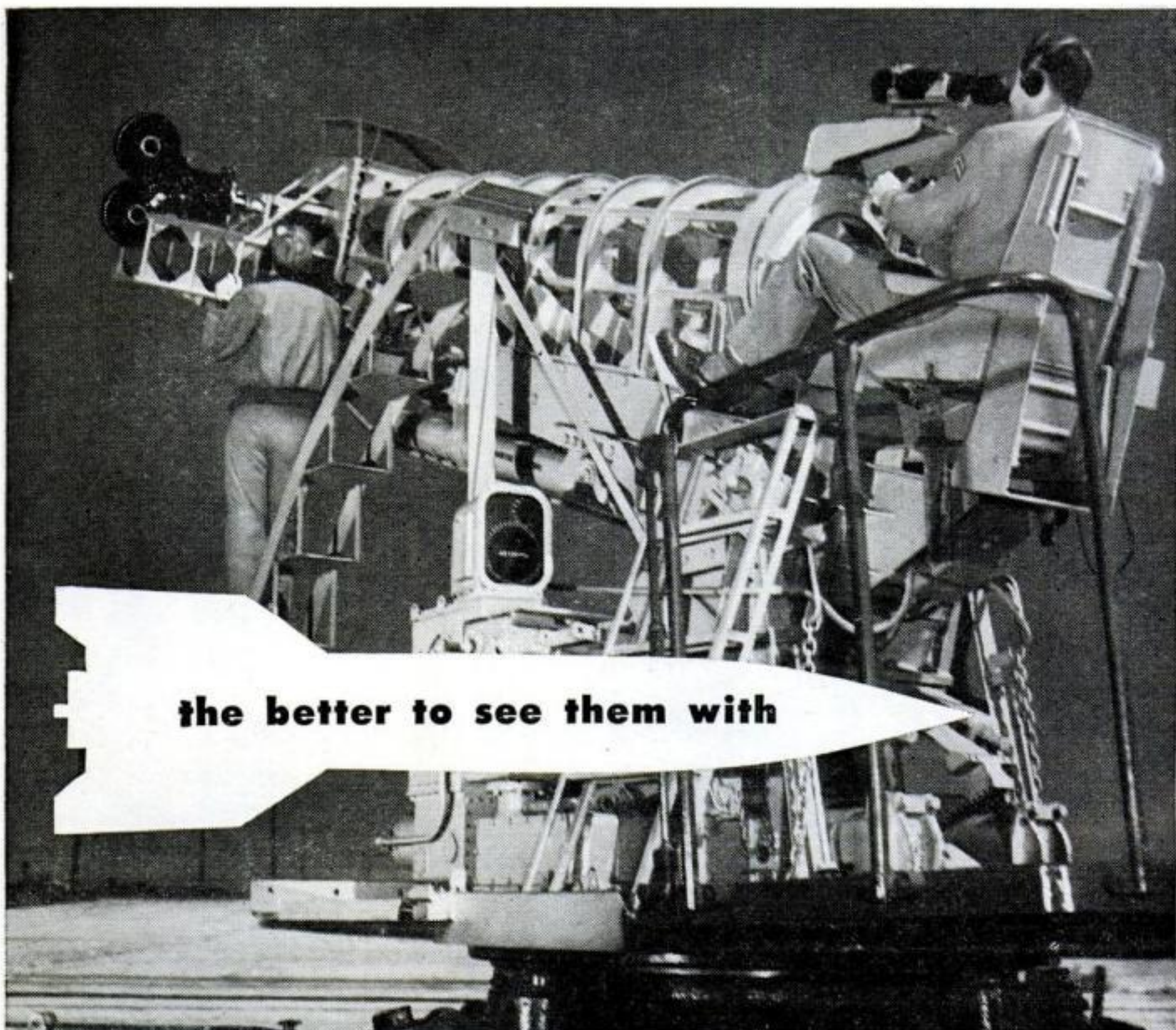


You can safely stock up stacks
Of modern, *power-full* Ray-O-Vacs!

Ask for Ray-O-Vac
Leak Proofs

Buy Spares... *they stay fresh*

Copyrighted material



the better to see them with

This colossal 16-inch reflecting telescope was designed and built by the U. S. Army's Ordnance Department. Artillerymen and airmen will use it to study the flight of guided missiles whizzing along at 3000 miles an hour at altitudes of 100 miles or more.

The telescope, fixed to an anti-aircraft gun mount, tracks three and four degrees per second in azimuth and elevation, respectively. A 35-mm. camera attachment records the image produced by the telescope, takes 15 exposures every second. Experts are thus able to check missile controls, collect aerodynamic information, and follow ejection of instruments attached to the missiles.

The reflecting telescope is another spectacular example of what the U. S.

Army is accomplishing in the fascinating realm of research and development. Thousands of projects, covering virtually every scientific field, are going forward daily at Army laboratories and proving grounds. If you want to be a member of an organization that is leading the way to great new things for the future, consider the U. S. Army. There are many new programs available specifically to young men interested in science. Your nearest U. S. Army and U. S. Air Force Recruiting Station will be glad to give you full details.

U. S. Army and U. S. Air Force Recruiting Service

CAREERS WITH A FUTURE

**U. S. Army and
U. S. Air Force**

**APRIL 6
IS ARMY DAY**

• Watch your local papers for announcement of nearby exhibits.

Any time is time for fun with a **HARLEY-DAVIDSON**

You've got the "greenlight" to good times, when you own a Harley-Davidson. Fun is around every corner, happiness along every highway in the world's greatest sport — motorcycling! Alone or with gay companions, there's no end to enjoyment. Within easy reach whenever you want to go are gypsy tours, hillclimbs, race meets, sightseeing trips, exciting vacations, all beckoning to new pleasures and adventures. Owning a Harley-Davidson is easier than you think. See your dealer today.

HARLEY-DAVIDSON MOTORCYCLES



HARLEY-DAVIDSON MOTOR CO., Dept. PS, Milwaukee 1, Wis.
Send free copy of ENTHUSIAST magazine, filled with motorcycle action pictures and stories; also literature on 1948 models.

Name.....
Street or R.F.D.....
City.....Zone.....State.....

**ALL YOURS
FOR YEARS
in a Johnson**



- | | |
|---------------------------------|---------------------------------|
| Perfected Alternate Firing | Weedless Propeller |
| Dual Carburetion | Stainless Steel Propeller Shaft |
| Reverse | Grease Seals |
| Ready-Pull Starter | Big Grease Capacity |
| Positive Primer | Big Gas Capacity |
| Synchro-Control | Automatic Oiling |
| Co-Pilot | Hardened Steel Gears |
| Salt Water Protective Treatment | Rubber Flow Shock Absorber |
| Rubber Rotor Pump | |



Yours for YEARS
OF SWEET
PERFORMANCE

FREE HANDY CHART
New! Illustrates and charts the 5 great Johnsons for '48. Sent free. Write! Look for the name of your Johnson dealer under "Outboard Motors" in your classified phone book. See him!
JOHNSON MOTORS
500 Pershing Rd., Waukegan, Ill.
Johnson Motors of Canada
Peterboro, Canada

JOHNSON
SEA-HORSES
for DEPENDability



Pulls Staples with Ease


IT MAY look like a nail clipper, but it's actually a gadget that pulls out staples without tearing the paper or your fingernail. The tip is pushed under the staple and the top lever is pressed, pulling out the staple. When the handle is released, a spring snaps the staple out of the remover. It is made by Metal Products, Inc., of Los Angeles.

How to Be Happy if Haptical

IF YOU'RE a haptical person, your bent is for mechanical jobs that need the touch of your skillful fingers, advises Dr. V. Lowenfeld, art education professor at Penn State College. The word, invented by the Greeks, means "able to lay hold of" things. Opposite of the haptical people are the "visuals", who work chiefly with their eyes and get along best in such professions as surveying and architecture.

Muscles Are the Sole Trouble

IF YOU'RE footsore, you can blame any one of the 18 separate muscles, grouped in four muscle layers, found in the sole of your foot alone.



Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	3/32
Weight, Grams	8	3 1/2	2 1/2

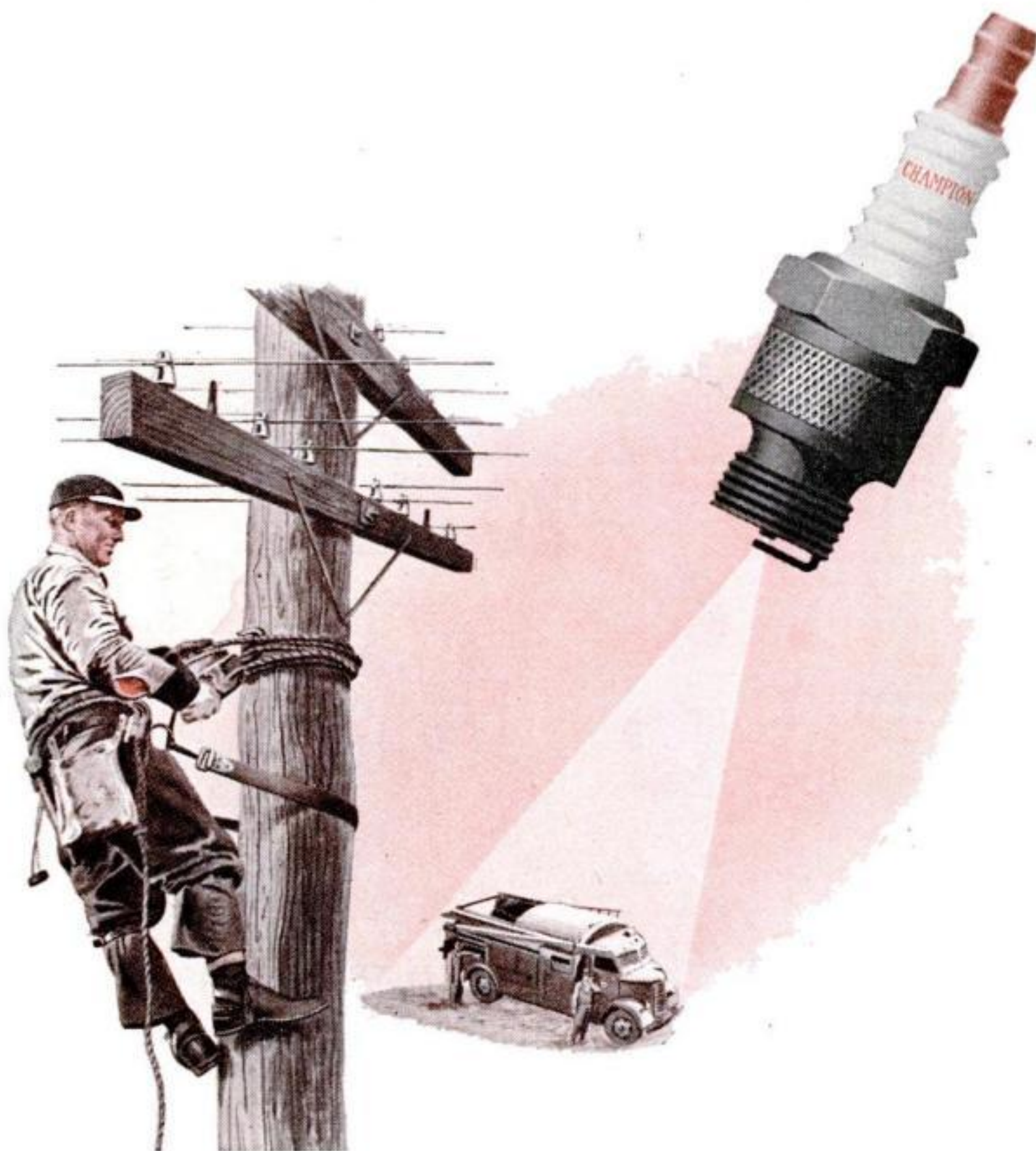
Actual Size V-Plug
Champion Spark Plugs for model gas engines give the same dependable performance as regular Champions. Champion Ceramic insulation—Sillment sealed. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION
SPARK PLUG COMPANY • TOLEDO 1, OHIO

Dependable

CHAMPION

America's Favorite Spark Plug



Utilities having a direct obligation to the public are exacting buyers of such vital equipment as spark plugs. Their fleets must have dependable ignition. Ex-

perts on spark plug performance and dependability, the majority specify dependable Champion Spark Plugs. Champion Spark Plug Company, Toledo 1, Ohio.

FOLLOW THE EXPERTS—DEMAND NEW DEPENDABLE CHAMPIONS FOR YOUR CAR

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

APRIL 1948 249



Wading a trout stream, or fly casting for bass or panfish—there's angling sport that's tops. You're sure of more exciting fun, greater thrills if your tackle is *right*. Outfit yourself with South Bend fly fishing tackle... and experience the difference that fine quality makes. Its sweet performance will make you want to keep fishing all day.

No. 59 SPLIT BAMBOO FLY ROD

Famous for action and quality. Patented "Comficient" grip. Lgth. 9'. Bass or steelhead action—\$16. Dry fly action models—\$16, \$22.50, \$25. Other bass or steelhead models—\$22.50 and \$25.

OREN-O-MATIC REEL

The balanced reel. Most popular automatic fly rod reel ever made. Free-stripping. Silent. Maroon finish. \$10 and \$10.50.



EXCEL-ORENO LINE

Long wearing, easy casting nylon line. Level sizes G to C, \$1.85 to \$2.80 a coil. Double tapers HEH, HDH, HCH, \$9. Silk slightly higher.



No. 593 TRIX-ORENO

The marvel fly rod lure. The "trickiest" lure ever designed—flutters like a bug. 65¢. Also, 2 bait casting models.



FREE! New '48 Book on Fishing

"Fishing—What Tackle and When" shows South Bend and Oreno tackle. Color pictures of fishes. Fly and bait casting instructions. Every fisherman needs a copy. Write for your copy today. Sent FREE!

SOUTH BEND BAIT COMPANY
892 HIGH ST., SOUTH BEND 23, INDIANA

BETTER
FISHING
INC.

SOUTH BEND
A Name Famous in Fishing



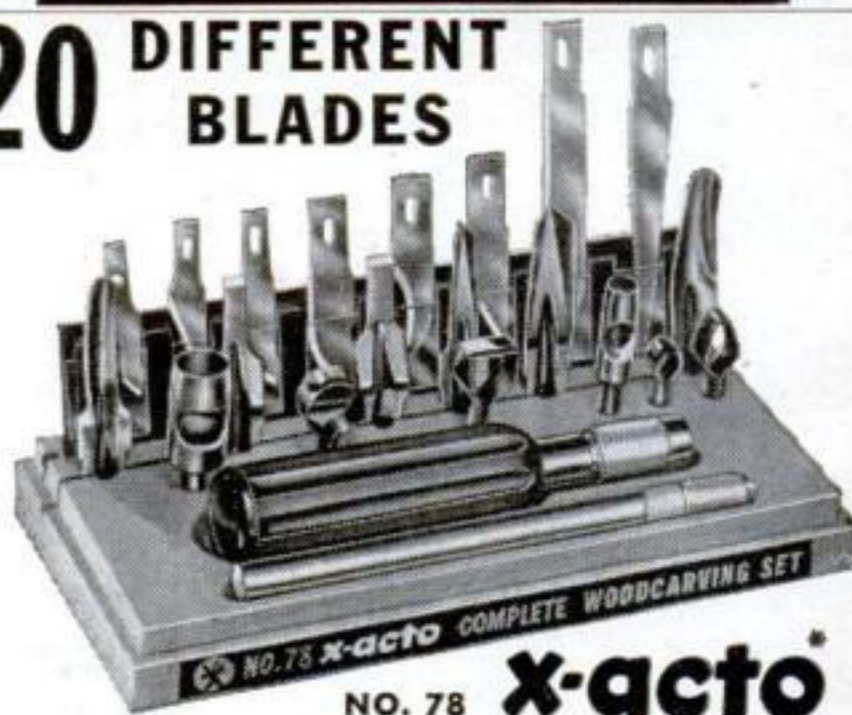
CALL TO ADVENTURE

You're a wilderness ranger in your Old Town Canoe. Paddle to hidden pools and cast your line where the big ones rise. Trust to your Old Town Canoe to get you there—and back. Birchbark-light, yet wiry-strong. Perfectly balanced. Built to last.

FREE CATALOG shows all kinds of canoes for paddling, for sailing, for outboards. Also sailboats, outboard boats, dinghies, rowboats. Send for it today. Address Old Town Canoe Company, 444 Wood Street, Old Town, Maine.

"Old Town Canoes"

20 DIFFERENT BLADES



NO. 78 **X-acto**
COMPLETE CARVING SET

Here's everything you need for a super-slick job, from toothpicks to totem poles. Super-sharp blades, firm-grip handles for light and heavy work. Ideal for wood, linoleum, plastics, etc. Contains: 6 different gouges, 4 routers, 2 punches, 6 regular blades, 2 three-inch blades, one No. 1 knife, one No. 5 knife. On wooden block, complete.....**Only \$5.00**

*Reg. U. S. Pat. Off.

Other X-acto Knives, Blades, Tools and Sets, 50¢ to \$50
Prices slightly higher in Canada

At hobby, gift, hardware and department stores

X-acto Crescent Prod. Co., Inc., 440—4th Ave., N. Y. 16
In Canada: Handicraft Tools, Ltd., Hermant Bldg., Toronto

*No rust
for the
wary!*



Clean rust out of your radiator with

DU PONT Cooling System CLEANSER

Drain out your anti-freeze, and clean out winter's accumulation of scum, scale, and rust. Neglect now may mean trouble and costly repairs later. Just pour a can of DU PONT COOLING SYSTEM CLEANSER into your radiator, run the engine 30 minutes or more, and drain. It dissolves rust—cleans thoroughly—improves engine performance. It's safe, sure, and easy to use.



Keep out rust with

DU PONT Acid and Rust INHIBITOR

After cleaning out the radiator, you can keep it free from rust all season by pouring in a can of DU PONT ACID AND RUST INHIBITOR. It prevents rust forming, and keeps out acid, too.



Avoid radiator leaks with

DU PONT Cooling System SEALER

Stop leaks quickly and securely—and make the cooling system LEAKPROOF—by pouring in DU PONT COOLING SYSTEM SEALER. It will not clog the radiator.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY

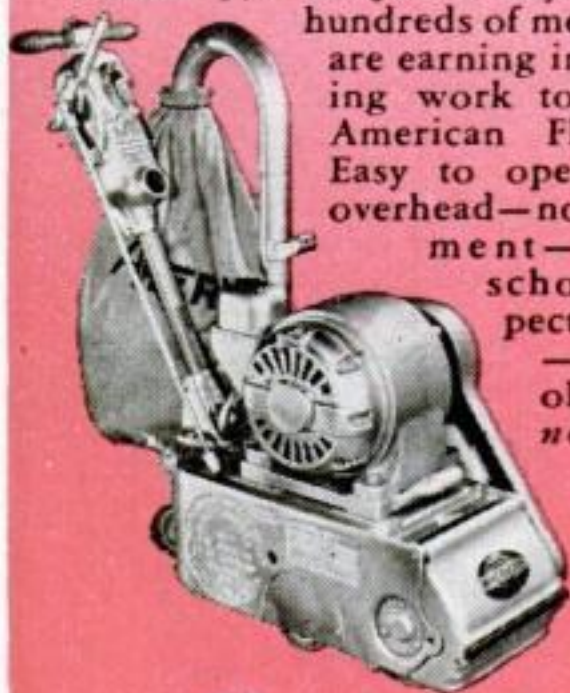
"Thanks a Million, American..."



**YOU SHOWED ME HOW TO
MAKE MONEY
IN A BUSINESS ALL MY OWN!"**

Now—you, too, can be your own boss and step into *big profits* in the building industry as a floor surfacing contractor! Make \$35 to \$50 a day—that's what

hundreds of men everywhere are earning in floor surfacing work today with an American Floor Sander! Easy to operate—no big overhead—no large investment—no special schooling. Prospects everywhere—sand new and old floors. Start now and get ahead! Send coupon for money-making booklet.



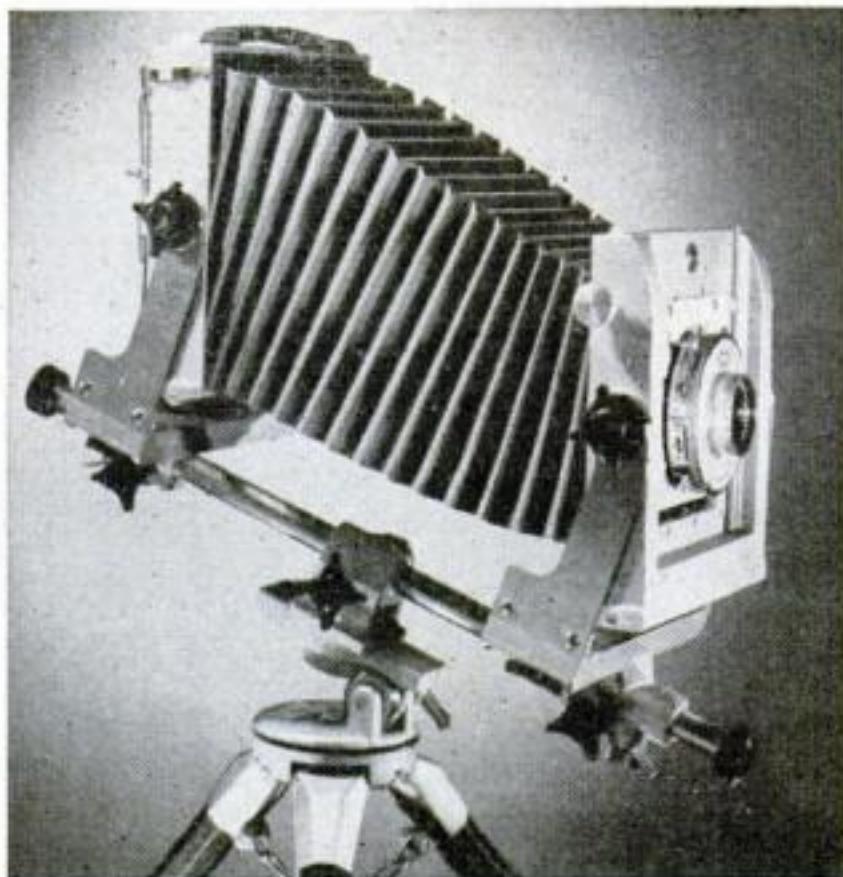
AMERICAN

FLOOR MACHINES

The American Floor Surfacing Machine Co.
532 So. St. Clair St., Toledo 3, Ohio

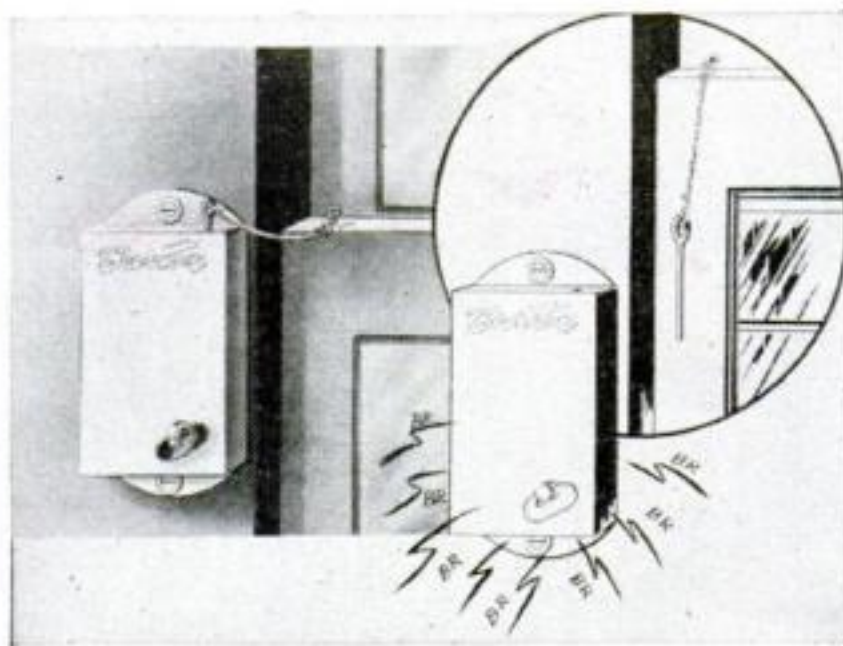
Enclosed find 25c in stamps or coin for booklet "Opportunities in Floor Surfacing", telling me how I can start my own floor sanding business.

Name.....
Street.....
City..... State.....



Improved View Camera

A REVOLVING back that can be used for framing pictures at any point throughout a complete circle is featured in this new Kodak 4x5 Master View Camera. Both the back and front swing, and spirit levels on both top and side assure perfect camera alignment. The monorail track permits a 15-inch bellows extension, and a special ground-glass-release handle makes it possible to insert or remove film holders without jarring the camera. It uses film or plate holders as well as film-pack adapters.



Window Burglar Alarm

OPENING of a window sets off this new, simple burglar alarm. A pin inserted in top of the alarm box (above, left) is attached to the window. When the latter is raised the pin is pulled out (above, right), operating a loud alarm mechanism. The device, which requires no batteries, is made by the Barton Engineering Co., of Detroit.

What's your choice of these

Marlin .22's?

Marlin Model 39-A—25-shot Lever Action Repeating Rifle. \$50.45*

Marlin Model 81-DL—25-shot Tubular Magazine Repeating Rifle. \$26.95*

Marlin Model 80-DL—8-shot Clip Magazine Repeating Rifle. \$22.90*

**Prices slightly higher west of the Rockies*

Be sure to see these three fine Marlin '48 models at your dealer's soon! Each is an outstanding rifle in its class.

● Here you have three great rifles for small game and all around sport. Marlin's 39-A is the only lever action .22 repeater made...a favorite in hunting circles the world over since 1892. As a practical weapon for vermin and small game, the 81-DL is a wise selection. It carries a full day's ammunition, and its light weight is a great asset in the field. The loaded clip of the 80-DL provides extra shots for fast-running game ...and allows use as a single loader for target work. All three are rugged, man-sized Marlin's, famous for accuracy and dependability. All shoot .22 short, long and long rifle cartridges—regular or high speed—without adjustment. Whichever you choose, you'll buy years and years of trouble-free sport!

American Black Walnut Stocks & Forends Standard on All Models

Marlin .22 Rifles

Outstanding for accuracy, dependability, long life



Often called the "world's best all around .22," Marlin's 39-A is a light rifle of remarkable accuracy and versatility. Only lever action .22 made. Extra fast for snap and exhibition shooting.



A full day's hunting is provided by the large 25-shot capacity of the Marlin 81-DL. Removable bolt assembly; Off and On safety...a fine "learning gun."



12 for 25¢ • Single or double edge

THE MARLIN FIREARMS CO., NEW HAVEN, CONN. • Fine Guns Since 1870

APRIL 1948 253



**OVER
30,000,000 IN USE
TODAY**

Pulsing steadily, nearly 100,000 times an hour, your AC Fuel Pump is the strong, reliable heart of your fuel system. It has given you long, faithful service because of its inbuilt quality and scientific design.

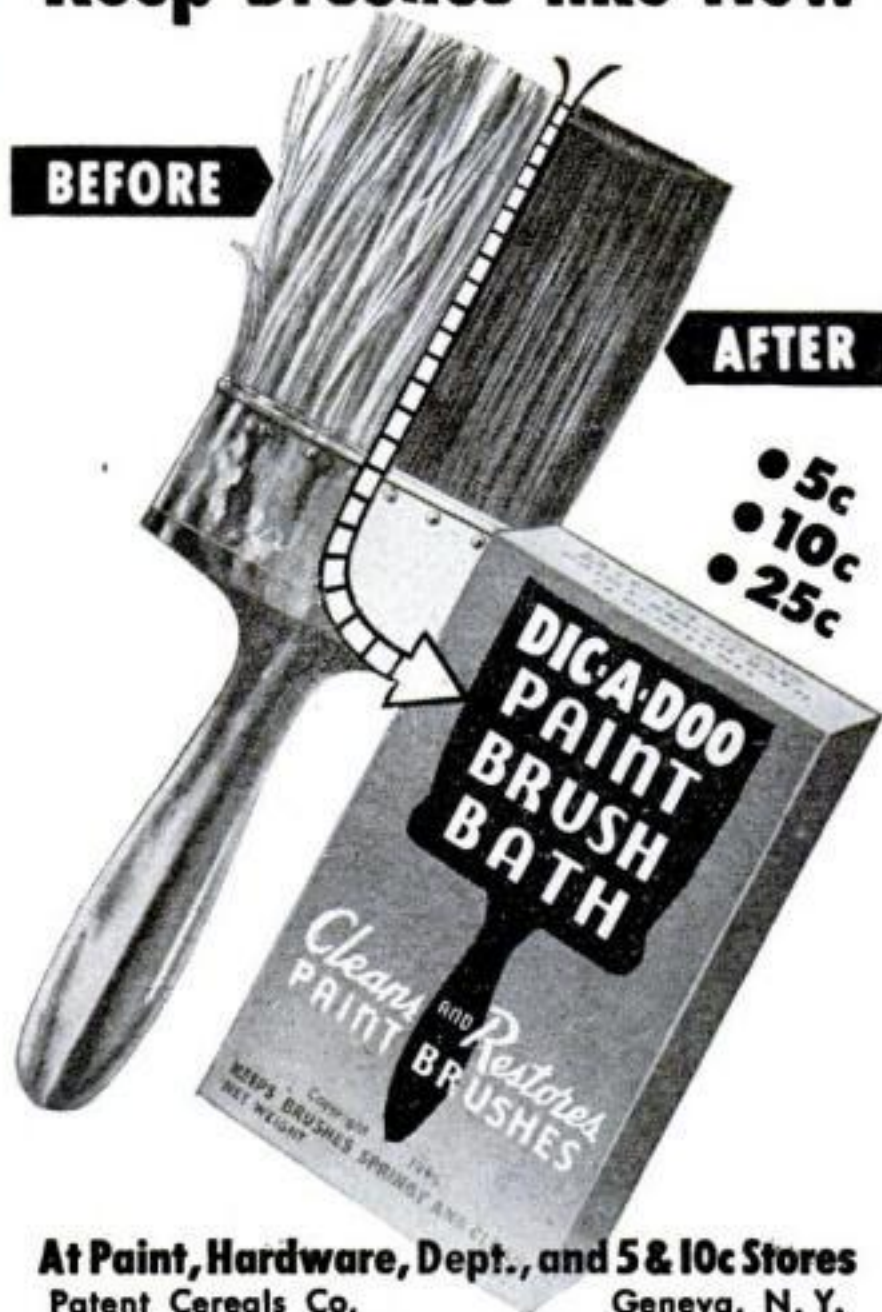
You can prolong that faithful service indefinitely, if you insist upon a new AC when you replace your present pump.

There is no satisfactory substitute for quality.



AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

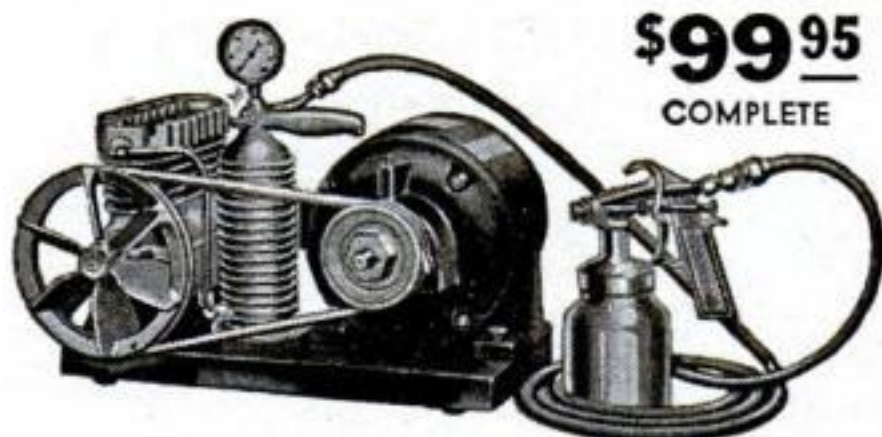
Keep Brushes like New



At Paint, Hardware, Dept., and 5 & 10c Stores
Patent Cereals Co. Geneva, N. Y.

PRESSURE QUEEN

FOUR CYLINDER
PORTABLE AIR COMPRESSOR
SPRAY PAINTING OUTFIT



\$99⁹⁵
COMPLETE

COMPACT • RUGGED • POWERFUL

The ideal air supply for home and farm workshop, machine shop, garage, service station and contracting painter. Inflates tires; refinishes automobiles, trucks, implements and furniture. Paints buildings better, faster and at lower cost than brush work. Compressor has 4 cylinders, drop forged crankshaft, heat treated valves and pistons, bronze bearings, forced feed lubrication. 50-60 lbs. pressure without pulsation. Price includes compressor as shown, with air gauge, 15 ft. hose, spray gun and $\frac{1}{3}$ h.p. motor; fully guaranteed. With $\frac{1}{2}$ h.p. motor—\$109.95.

IF YOUR DEALER DOES NOT SELL
PRESSURE QUEEN WRITE DIRECT.

THE CAMPBELL-HAUSFELD CO.

151 RAILROAD AVE.

HARRISON, OHIO



QUALITY

TABLE MODEL TILT-ARBOR SAWS

OIL IMPREGNATED BRONZE BEARINGS OR DOUBLE SHIELDED BALL BEARINGS, BOTH WITH THE PATENTED BALL BEARING TRANS-AXIAL MOTOR DRIVE

TABLE 18" x 16"

BRONZE BEARING

\$4495

F.O.B.

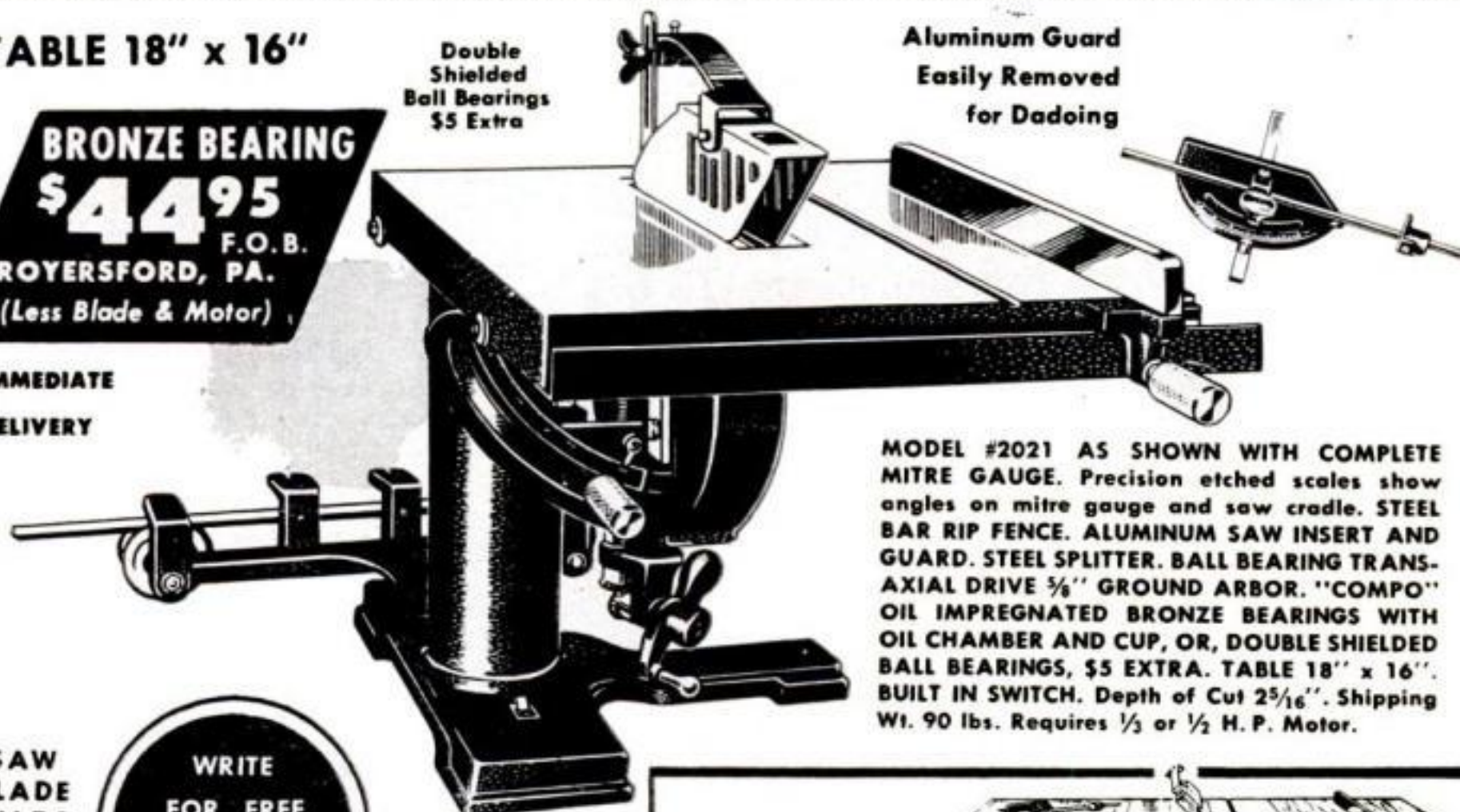
ROYERSFORD, PA.

(Less Blade & Motor)

**IMMEDIATE
DELIVERY**

Double
Shielded
Ball Bearings
\$5 Extra

Aluminum Guard
Easily Removed
for Dadoing



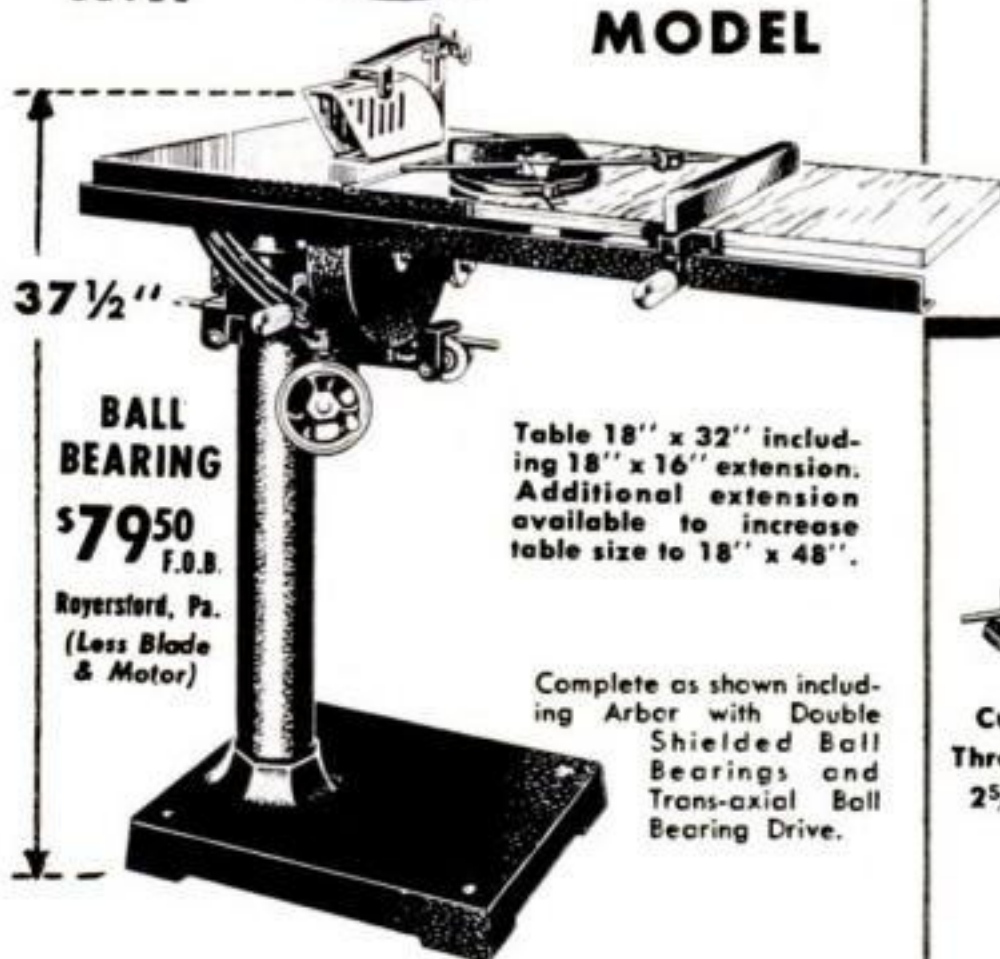
MODEL #2021 AS SHOWN WITH COMPLETE MITRE GAUGE. Precision etched scales show angles on mitre gauge and saw cradle. STEEL BAR RIP FENCE. ALUMINUM SAW INSERT AND GUARD. STEEL SPLITTER. BALL BEARING TRANS-AXIAL DRIVE $\frac{5}{8}$ " GROUND ARBOR. "COMPO" OIL IMPREGNATED BRONZE BEARINGS WITH OIL CHAMBER AND CUP, OR, DOUBLE SHIELDED BALL BEARINGS, \$5 EXTRA. TABLE 18" x 16". BUILT IN SWITCH. Depth of Cut $2\frac{5}{16}$ ". Shipping Wt. 90 lbs. Requires $\frac{1}{3}$ or $\frac{1}{2}$ H. P. Motor.

SAW
BLADE
TILTS

WRITE
FOR FREE
ILLUSTRATED
FOLDER

TABLE
STAYS
LEVEL

**FLOOR
MODEL**



37 1/2"

**BALL
BEARING**

\$7950

F.O.B.

Royersford, Pa.

(Less Blade
& Motor)

Table 18" x 32" including 18" x 16" extension. Additional extension available to increase table size to 18" x 48".

Complete as shown including Arbor with Double Shielded Ball Bearings and Trans-axial Ball Bearing Drive.

Model #2021
With 2 Extensions
Makes Table 18" x 48"

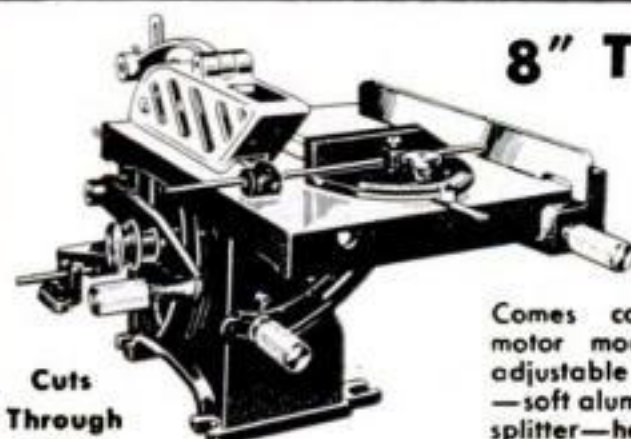


TABLES PRE-DRILLED FOR EXTENSIONS



1 EXTENSION
MAKES TABLE

18" x 32"



**8" TILT TABLE
BENCH
SAW**

Cuts
Through
 $2\frac{5}{16}$ "

\$2495
F.O.B.
ROYERSFORD, PA.

Comes complete with Floating motor mount—mitre gauge with adjustable stop—aluminum guard—soft aluminum insert—spring steel splitter—heavy gray iron fence—(no motor—no blade).

Table 12" x 14" Tilts to 45°—Oilite bearings. Shipping Wt. 50 lbs

COMPLETE AS SHOWN

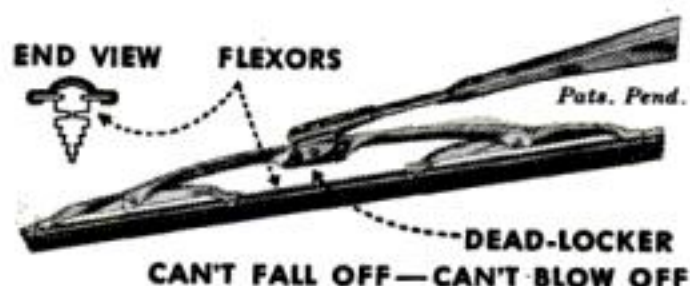
MARCUS • POLLAK

AMERICAN MACHINE & TOOL CO. INC.

—DEPT. 20—
ROYERSFORD, PA.

MACHINE BUILDERS AND IRON FOUNDERS FOR OVER A QUARTER OF A CENTURY

TRY THIS AMAZING NEW
ANCO® CLEAR-FLEX
Trade Mark
WINDSHIELD WIPER BLADE



FLEXES TO CLEAR THE LOW SPOTS

Know CLEAR-FLEX . . . the first Wiper Blade to conform fully to all windshield surface irregularities. Even wipes uniformly all types of curved windshields. Keeps clear those annoying hard-to-reach low spots common to all FLAT windshield glass. Clears quickly blinding road muck . . . slapped against your windshield from sloppy pavements . . . by passing cars. CLEAR-FLEX already has engineering approval for original equipment on coming models of high-grade cars.

THRILL WITH CLEAR-FLEX AS OUR "GUEST"

Deposit with your dealer only the regular retail price. Use CLEAR-FLEX through the next storm. Then IF you are willing, dealer is authorized to remove CLEAR-FLEX and refund all your money.

ANCO DEAD-LOCKER®



WIPER ARM

ANCO Arm fits quickly any wiper shaft. Suits any good wiper motor. Holds Blade true . . . at correct pressure. If not now on your car, ask serviceman to install a PAIR quickly for you. More than 250,000 good gas stations and service stores sell ANCO BETTER Blades and Arms.

Made by the makers of long-famous ANCO RAIN-MASTER® Blades and Arms . . . original equipment for years on DeLuxe models of high-grade cars. Your dealer knows ANCO.

**Get yours next time you buy gas.
 May save you a costly smashup.**

Quality Protected Under Fair Trade Laws
 ANCO Patented Products—Patents Make Jobs

THE ANDERSON COMPANY
 Established 1918
 GARY, INDIANA

No other tool like it!
BURGESS
vibro-tool
Trade Mark Reg. U. S. Pat. Off.

Writes on . . .

Watches
 Glassware
 Tools
 Leather
 Plastics

Costume
 Jewelry
 Pots and
 Pans
 Sporting
 Equipment



\$7.50

Engrave your name . . . etch letters or designs . . . place permanent identification marks on anything with this unique hand tool. Carves wood and linoleum, cuts cardboard and balsa, tools leather. Just plug in on any 110 volt AC line. No home shop is complete without a Burgess Vibro-Tool. See your dealer or write for information.



DELUXE KIT

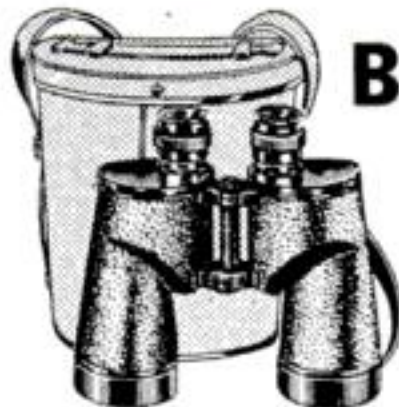
Vibro-Tool complete with 22 attachments in handsome, polished wood chest. . . . \$16.50

BURGESS Vibro-Tool Division

LAKE ZURICH, ILLINOIS

Get that NEW-CAR FEEL again!
SEALED POWER PISTON RINGS
The only ring with the Full-Flow Spring!
 SEALED POWER CORP., DEPT. H2, MUSKEGON, MICH.

U. S. NAVY 7x50
PRISM
BINOCULARS



with Coated Optics

Used but in
EXCELLENT CONDITION

\$95

Complete with leather
 carrying case and sling

Universal, 6 x 30 Navy Prism Binoculars, used but in excellent condition, complete with leather case and sling straps. . . . \$42.50

With Coated Optics, \$10 Extra.

Field Glass, 4 x 40 Wollensak. Ideal for bird study. Brand New. . . . \$17.95

Engineers All Metal Army Type Hand-Sighting

LEVELS
\$2.00 **PRECISION**
QUALITY



Send \$1.50 for 3rd Edition of Gun Digest with our complete catalog of new and used guns, etc. Our separate catalog 25c.

PUBLIC SPORT SHOPS

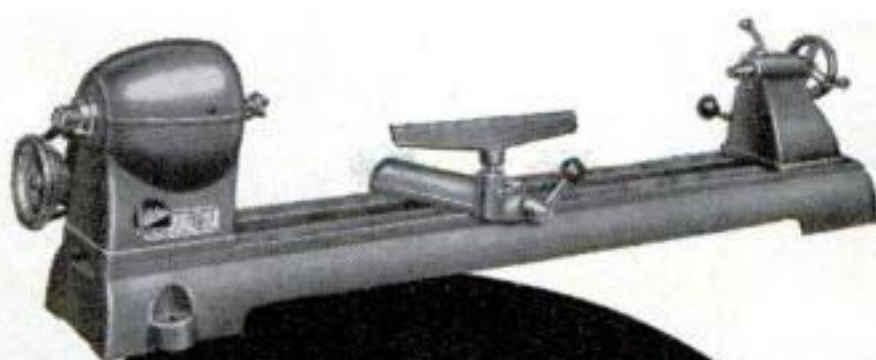
11 S. 16th St., Phila. 2, Pa.

No COD's

★ New Atlas
8" and 10"
TABLE SAWS

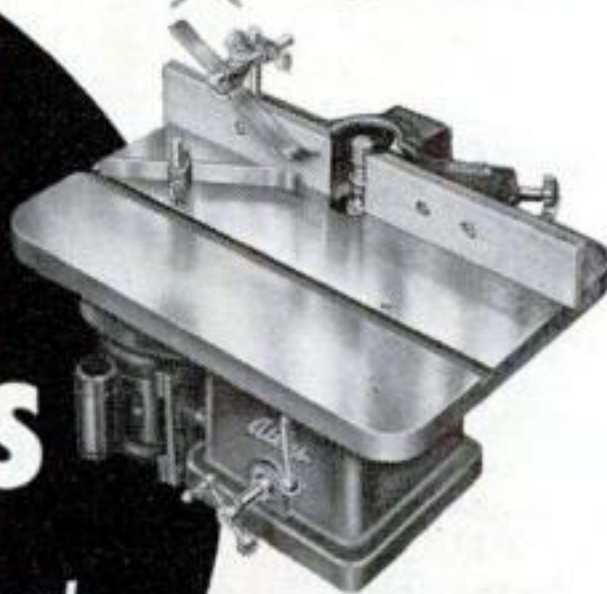


★ New Atlas
24" JIG SAW



★ New Atlas
12" WOOD LATHE

★ New Atlas
WOOD SHAPER



★ New Atlas
BELT and
DISC SANDER



6 MORE New Atlas TOOLS

Built to Industrial Standards
For New Perfection
in Your Shop

AVAILABLE NOW!



New Atlas 10"
Floor Saw. Every
feature you want
for fine workman-
ship. Heavy-duty.
Extra-large table.
Unique rip fence.
Easy-operating
controls.
PRICE \$179.50



New
ATLAS 12 3/4"
BENCH DRILL, \$59.00
ATLAS 15"
BENCH DRILL, \$69.00
ATLAS 15"
FLOOR DRILL, \$79.00

See them today at your
Atlas dealers.

All prices, less motors, F.O.B.
Kalamazoo, subject to change without notice.

★ THEY'RE COMING YOUR WAY...
6 brand-new Atlas woodworking tools . . .
precision-built throughout . . . for the finest
work you've ever produced in your shop!
These are the kind of tools the real craftsmen
in America have long been waiting for . . .
built to exacting industrial standards . . . with
every latest feature for accuracy, easy opera-
tion, and long service life. They'll make your
shop the best-equipped, most practical in your
neighborhood. Keep in touch with your Atlas
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show you soon!



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Kindly send latest literature on Atlas woodworking
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BRAND NEW!

Sensational

Screw Drivers

- with new hand-fitted handles made of superior plastic—make all others out-of-date!

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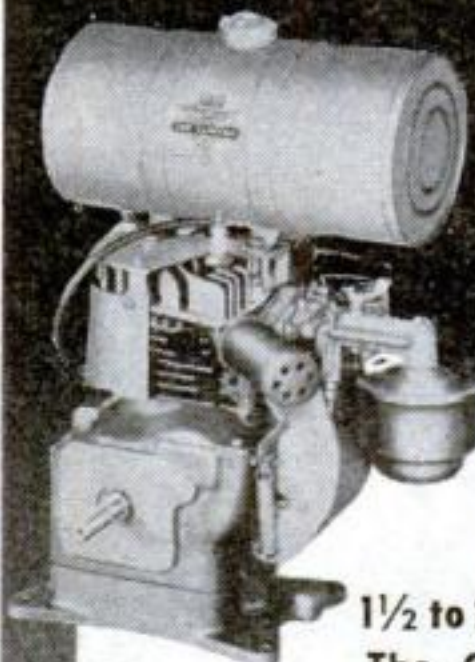
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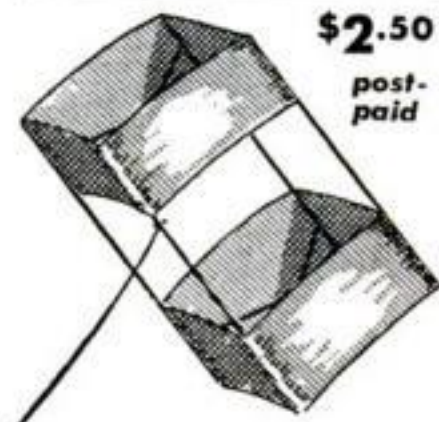


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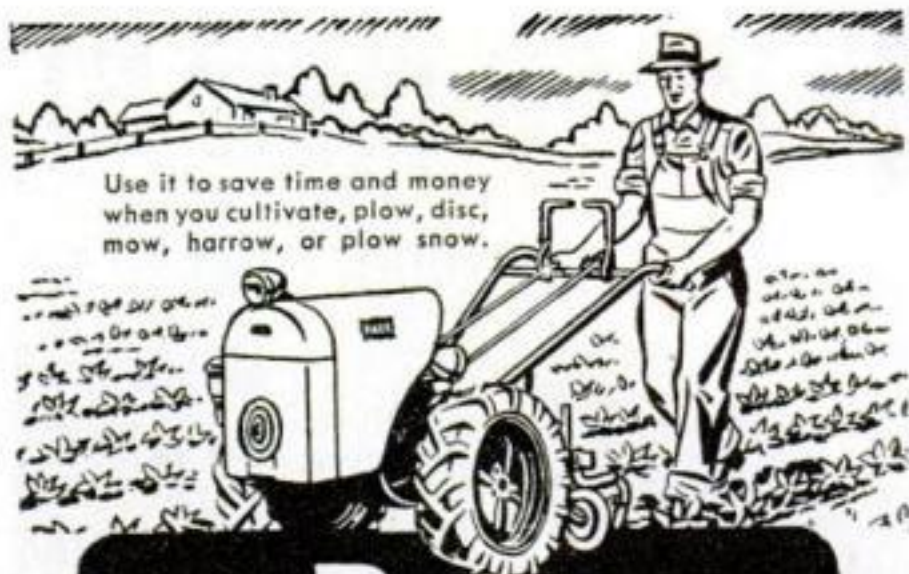
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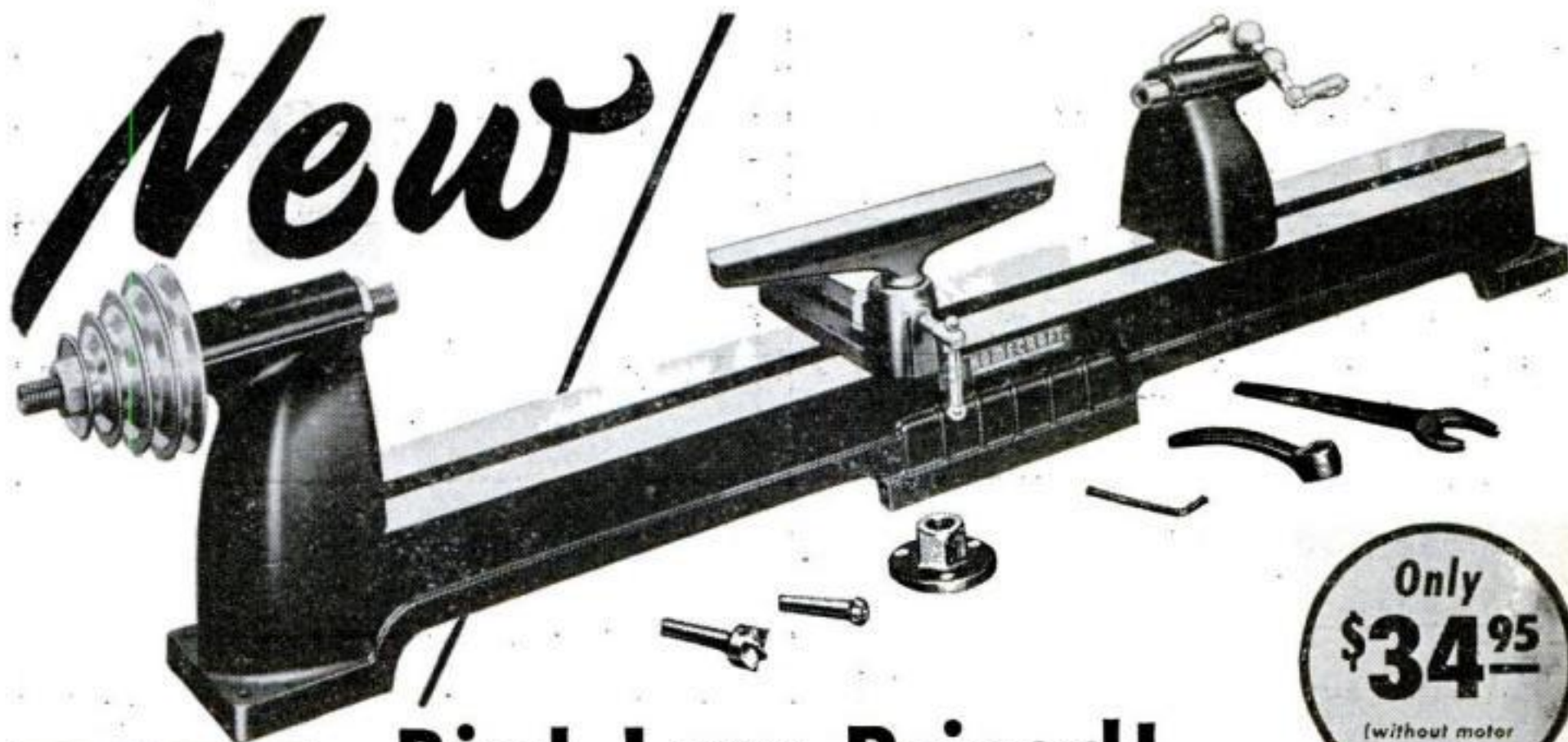
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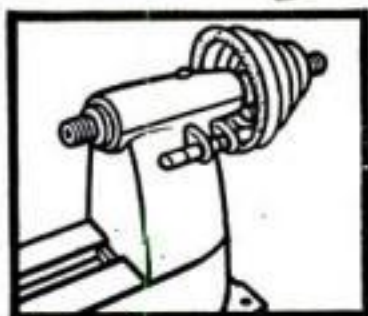
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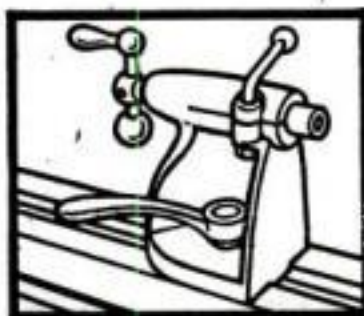
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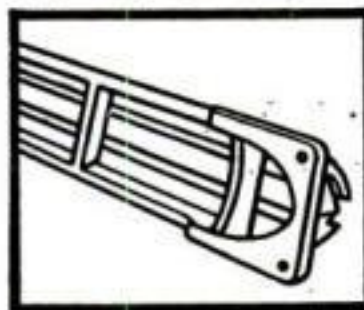


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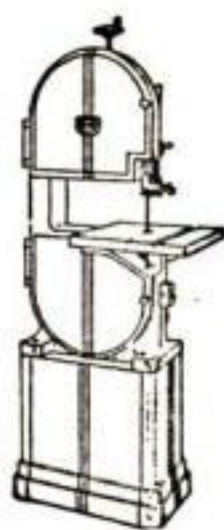
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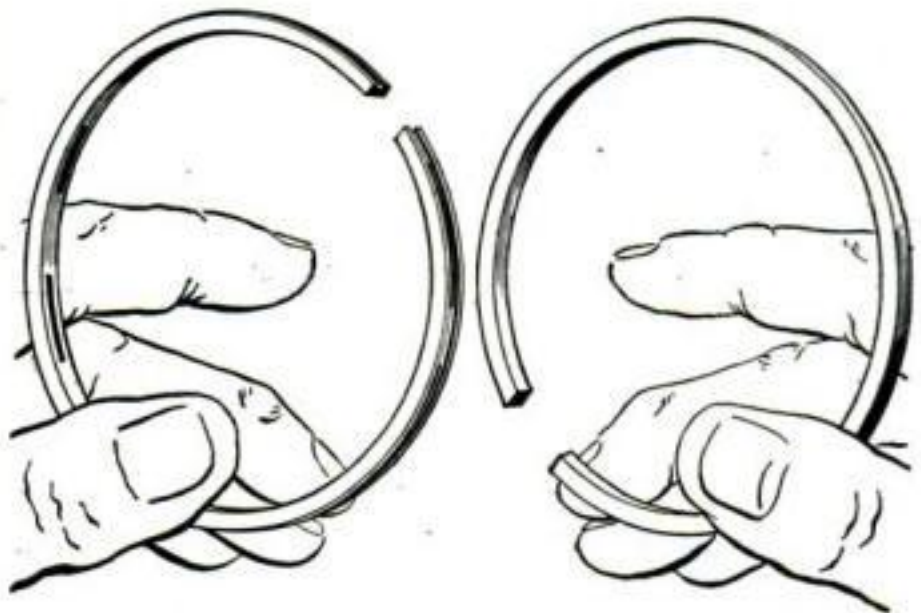
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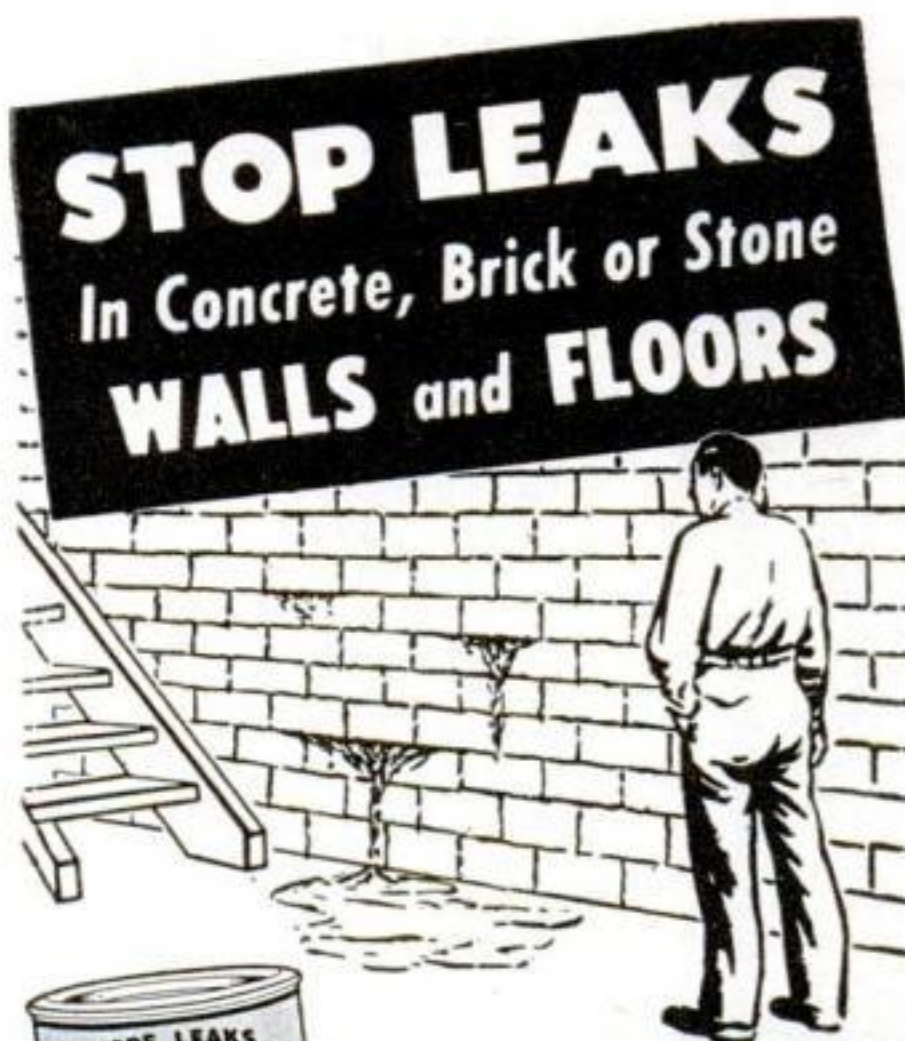
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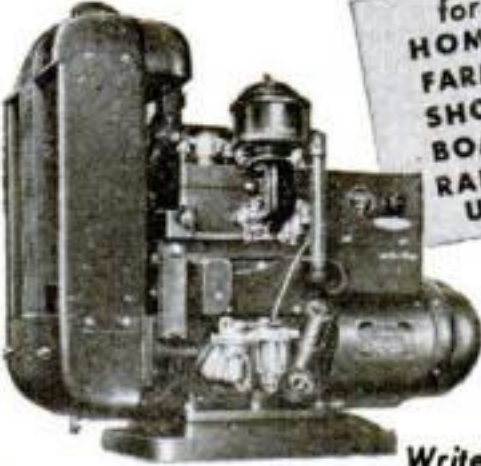


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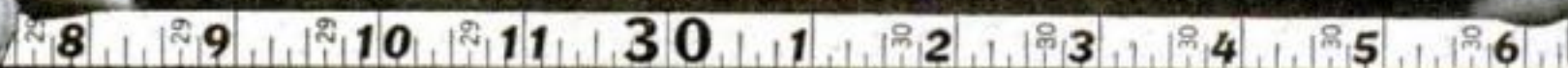
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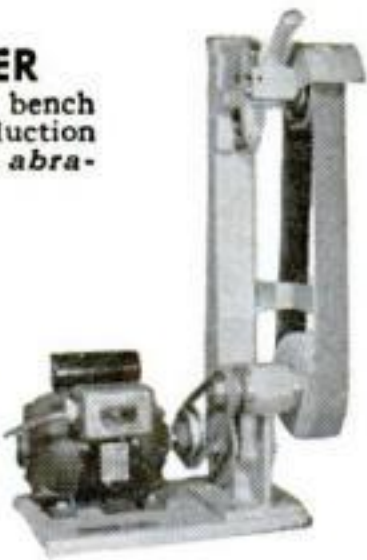
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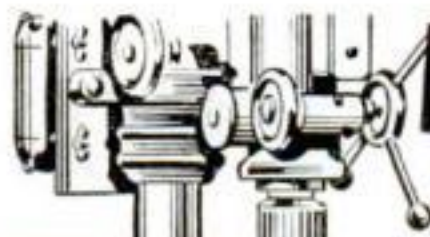
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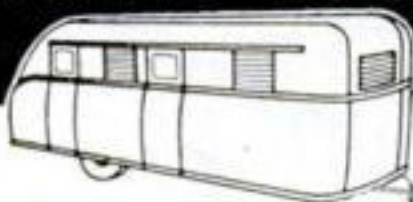
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Anyone can quickly learn to use the new P&H Dial-lectric welder. There is only one control — the dial is clearly marked and a $\frac{1}{4}$ turn of the radio-like knob covers the entire welding range. There are no plug-ins to make, no wheels or levers to crank or adjust — welding is just plain easy with a P&H Dial-lectric machine. A clearly illustrated, easily understood welding manual is supplied with each machine so that beginners can learn to weld in an extremely short time. Old hands may pick up some new tricks, too.

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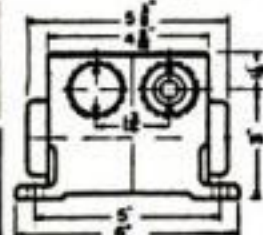
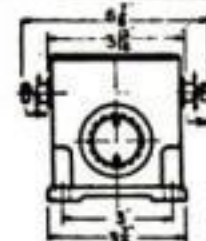
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2	.855	13/16	20	.8595	3-5/16	1.095	15
5	1.250	3/4	20	1.2495	3-9/32	1.452	10
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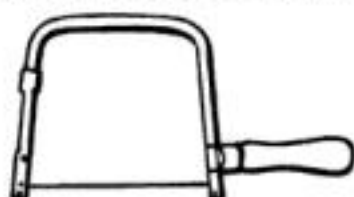
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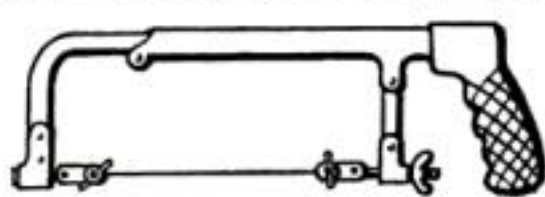
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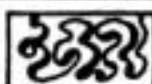
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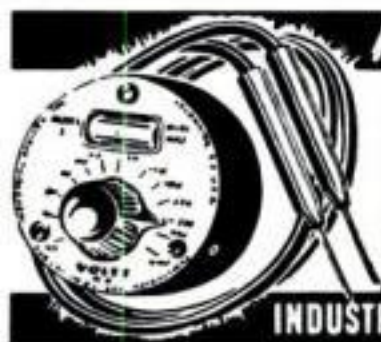
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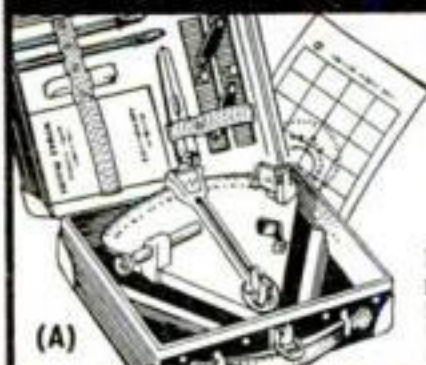
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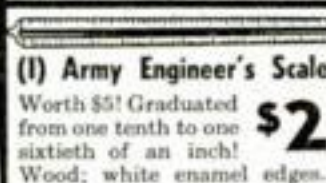
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19.95**

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For drafting, work bench, home study. Heavy metal tubing. 4-way swivel. 44-in. reach. Heavy-duty clamp. 10 ft. of heavy cord.

STAR SURPLUS SPECIALS FOR CAMPERS!



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(M) OFFICER'S CANVAS BEDROLL & RECON. ALL-WOOL ARMY BLANKET... BOTH FOR \$7.50

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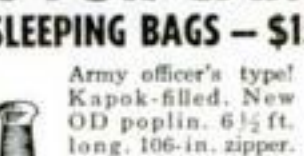
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**ARMY
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Comes in 2 halves. Poles included! Plenty of room for 2 campers! Buy two, put 'em together, and sleep 4! As good as new! **\$3.95**



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The Sea Shell is an inexpensive, all-purpose man-sized boat for salt water or fresh. Ideal for fishermen, duck hunters, yachtsmen and youngsters.

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Tungsten Carbide — carefully ground on diamond laps, brazed into stainless steel 6" handle for marking steel and other metals — for etching, marking, cutting glass. In plastic case with pocket clip.



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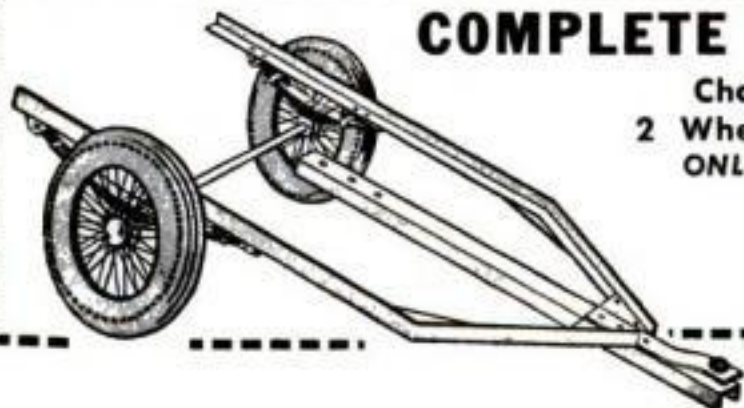
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Chassis-Axle
2 Wheel Assembly
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Never before offered at this low price. Tested to carry 1000 lbs.—built to take hardest usage . . . **COMPARE!**—in construction—utility—value! You'll agree there's nothing like it.

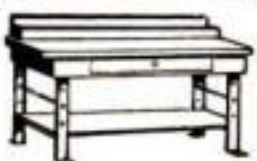
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Solid, tough wood construction—**ALL STEEL LEGS**. Very large drawer, tool rack, shelf, 34 1/2" high, 59" x 23". **COMPLETE WITH ALL HARDWARE**. Shipped KD with easy instructions. **ONLY \$15.35 F.O.B., Yonkers.**



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SINGLE EXHAUST BLOWER DELIVERS 100 CU. FT. AIR PER MINUTE. Ready to install yourself with any household tools. It's built for that. Housing is solid cast aluminum to last indefinitely. 110 V., 50-60 cycles. Cont. duty motor.



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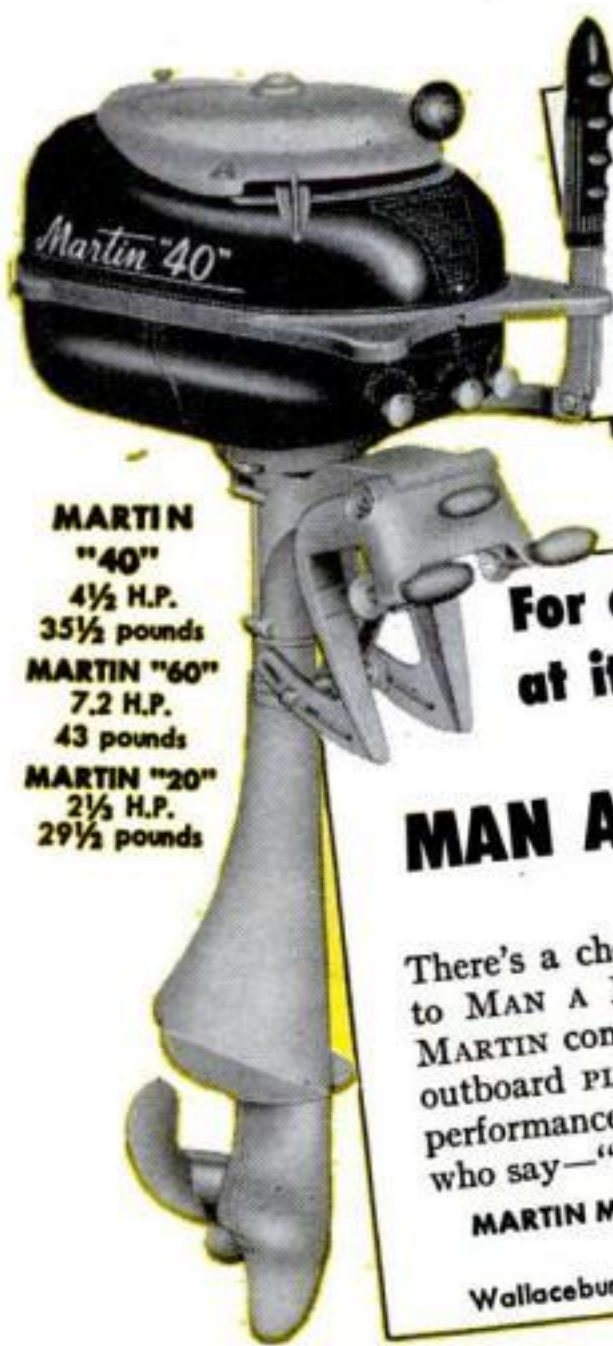


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with the overlapping pin that reinforces the telescopic joint . . . Raises, levels, supports sagging floors.

3'8" to 5'7" **\$6.95**
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 4½ H.P.
 35½ pounds
MARTIN "60"
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MAN A MARTIN for thrilling top speed performance. MARTIN's exclusive patented, mechanically-controlled poppet valves set a new standard of performance in outboard motors.

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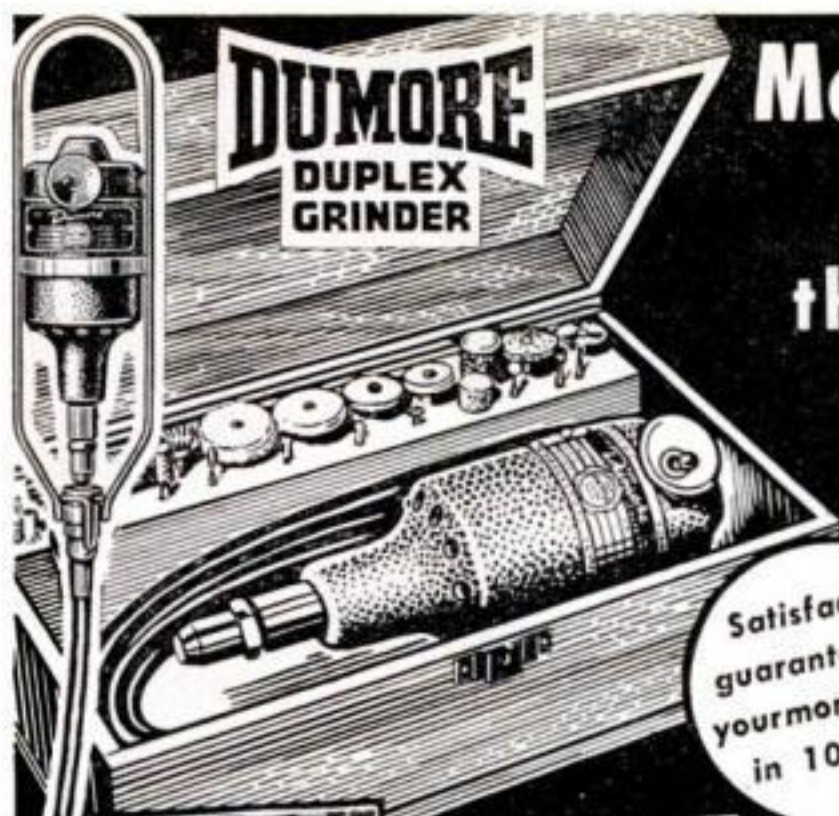
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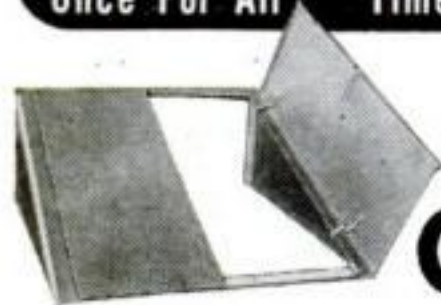
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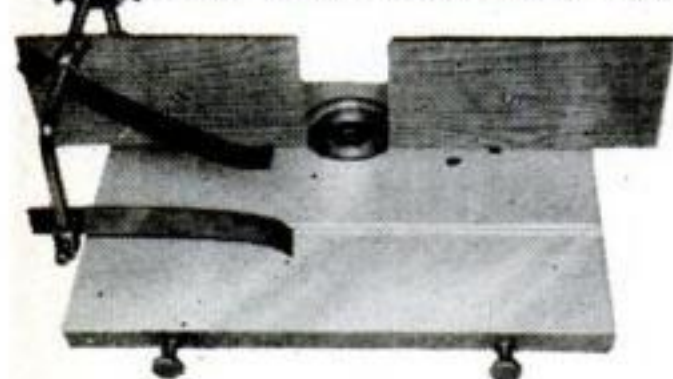
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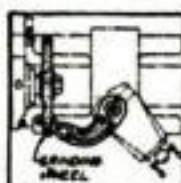
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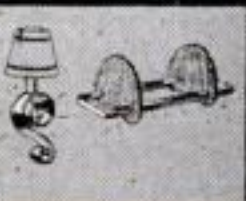
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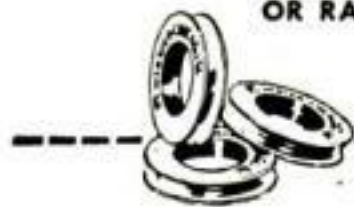
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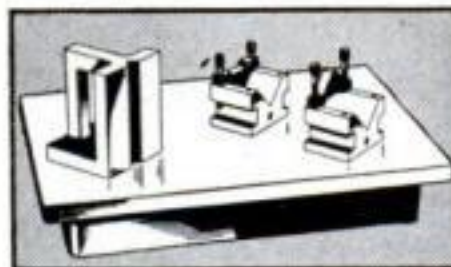
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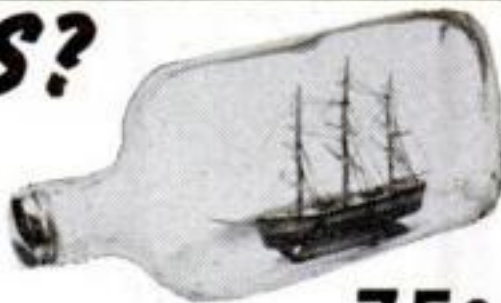



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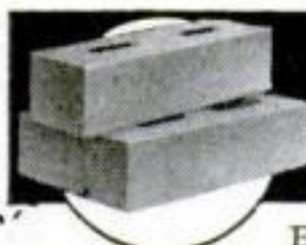
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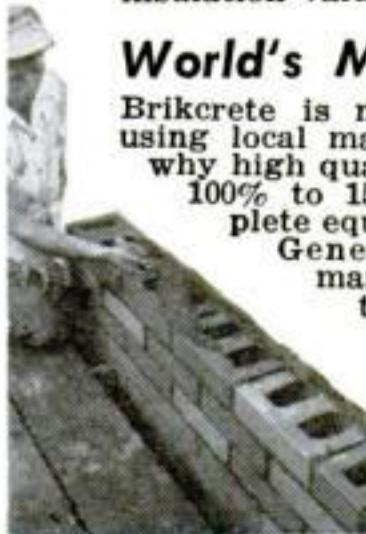
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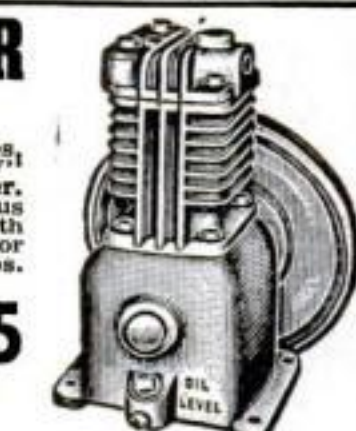
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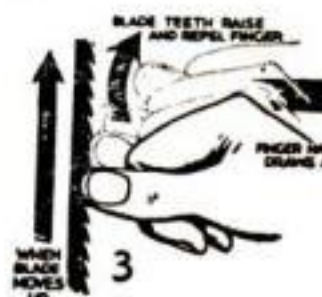
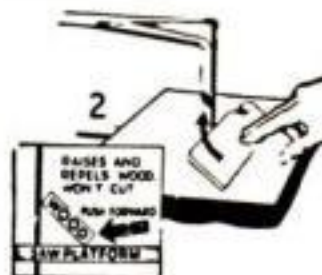
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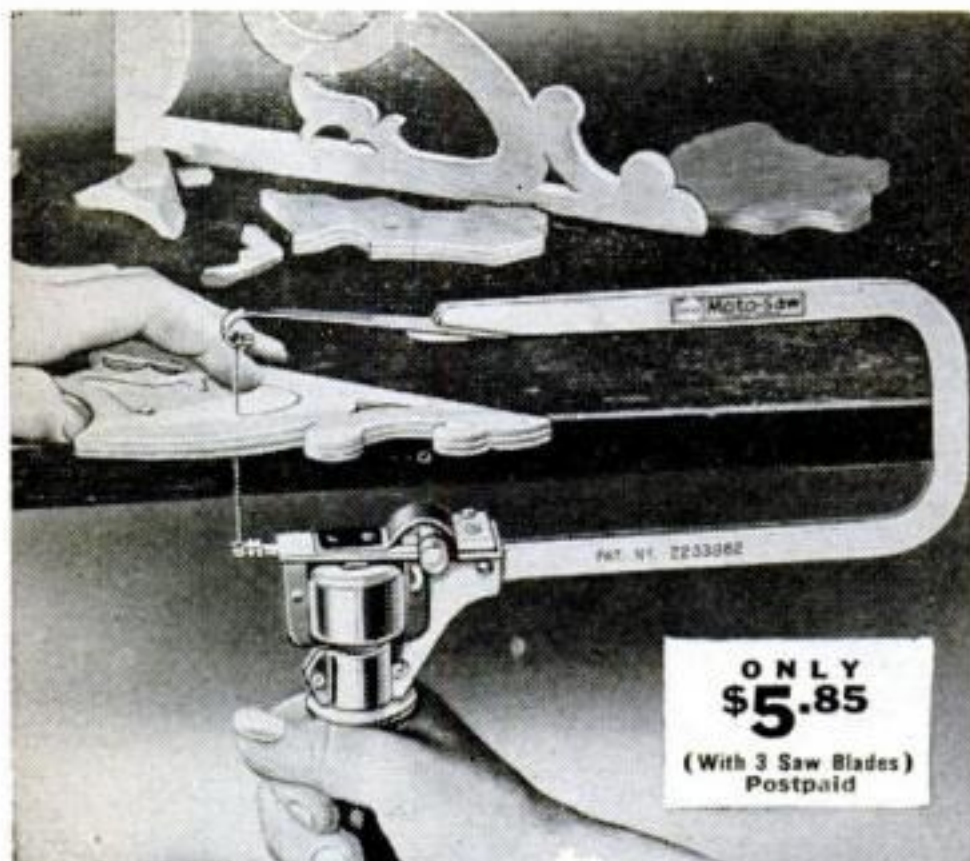
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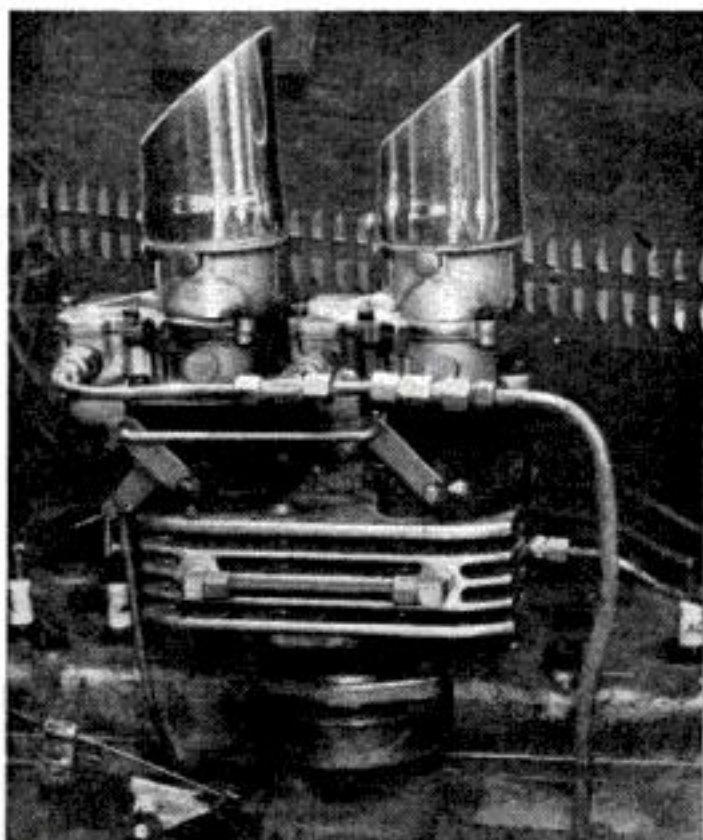
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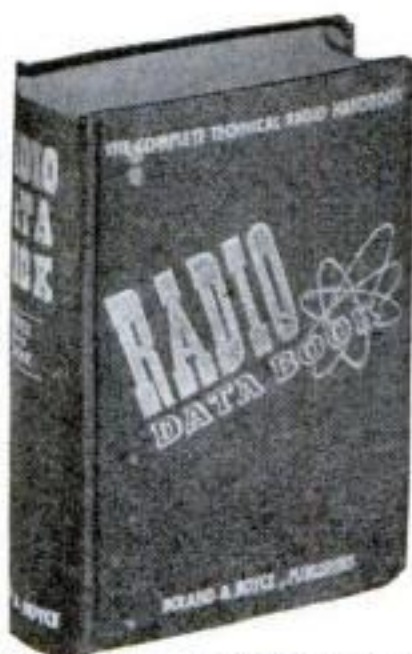
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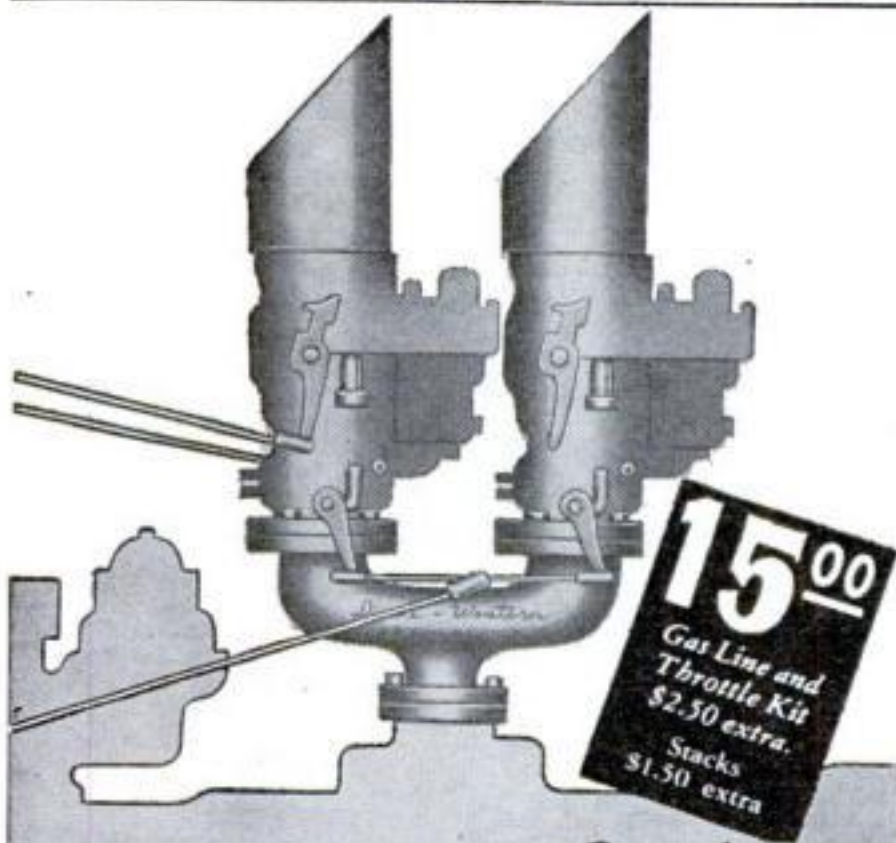
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Autos to Atoms

LAST month's issue was hardly cool before a couple of significant reactions came into the office.

Buick, not unnaturally, liked the article on its new Dynaflow transmission that offers literally limitless gear ratios in driving speeds. Buick was finding out that the development of the device was almost simple compared to the job of explaining how it worked.

We could well understand what they meant. One time or another most of the PS Editorial Staff had been doodling diagrams and cutting out paper dolls in attempts to explain the obvious but mysterious principles of the super-gadget. We even hauled out the office electric fans to test our theories. Such are the difficulties of picturing three-dimensional hydraulics.

The Dynaflow humbled the writer, the editors, and the whole art department into accepting the eventual explanation with the assurance that if *we* could understand it, anyone could get it.

Perhaps it was this unusual humility that convinced the Buick people that our explanation was just what they needed. Anyway, the Buick magazine is reprinting the POPULAR SCIENCE article on the Dynaflow. Glad to



get rid of it, gentlemen. Some of our people are still cutting circles in the air with their forefingers. Frankly, we'd rather drive than describe one.

Incidentally, the Dynaflow story wasn't born at Buick. It began with a Washington rumor that the torque converter used on tanks was being fiddled up for passenger

cars. Detroit detective work by Devon Francis led to Buick as the first to get a truly automatic drive on the road.

The other big boot we got out of the February POPULAR SCIENCE was the atomic energy business.

It began as a Chicago local story. We assigned Martin Mann to get on out there on the chance he might see a power pile in actual operation. We told him to look for the practical details that would let him write



an article honestly entitled, "How To Run An Atomic Power Plant."

"Be sure," we said as we bade the Mann good-bye, "you keep your pores open for how a going atom plant sounds and smells."

On his safe, unatomized, return we pounded him with the questions that were answered by the article. It looked, he reported, like a concrete garage inside a warehouse. The only sound was a faint hum—caused by the fans in the ventilation systems. It smelled, he said, "like a physics lab—kind of a vague machinery smell."

Since he had been shown nothing off the record, Mann sat down with artist Ray Pioch and talked out a drawing of a practical atomic power plant.

It must have been a pretty good drawing and article. Anyway, the Atomic Energy Commission thought so. The atom people called up for a couple of thousand reprints. They want to send them to—that's right!—the guys who work in the atom business.

This kind of thing makes us pretty cocky here at POPULAR SCIENCE. If it's good enough for the guys at Buick and the Atomic Energy Commission who really know these things, it ought to be good enough for the whole million of the rest of you readers.

But I guess I'd better pipe down. Too many experts in the audience, and we live on the end of too long a limb. Some knitting-machine expert is going to count the needles in the picture and tag us out!*



This One



3J1K-JB6-6S26

SHORT, SHORT LESSON IN FM AND TELEVISION

Here's why
WARD Magic Wand^{*} Aerials
make all receivers work better

Attach a Magic Wand aerial to your FM or television receiver, and the effect is almost magical. Fuzzy television pictures become sharp, clear, easy to see. FM tones ring out rich, full-throated, completely free of static and distortion. You get more stations, and you get them at their best.

Your FM or television receiver needs a Magic Wand outdoor aerial because it receives waves which are *very* short. Unlike the long waves of standard radio (AM) broadcast, which penetrate like sound; these short FM and television waves travel line-of-sight. They reflect off solid surfaces like light waves. Another difference: the longer, more powerful AM waves are reflected downward from the ionosphere (layers of ionized air which begin about thirty miles above the earth), thus they carry over the curvature of the earth for longer distances. FM waves are not so reflected, they carry out into space after they pass the horizon.

Tested and perfected in the famous Ward experimental laboratory, Magic Wand aerials are available in several types to fit varying conditions. They are quickly installed outdoors, at any roof or wall angle, where they pass maximum signal strength down to your receiver.

See your radio dealer, or serviceman, today. Have him help you choose the Magic Wand aerial best suited to your needs. They're priced from \$9.00 to \$18.00, and are complete with instructions and accessories. Get yours installed immediately, and start to enjoy the kind of performance you paid for.

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POWER LONGITUDINAL FEEDS—

Model A Lathes—48, .0015" to .0853"

Model B Lathes—26, .0021" to .0155"

Model C Lathes—14, .0021" to .0156"

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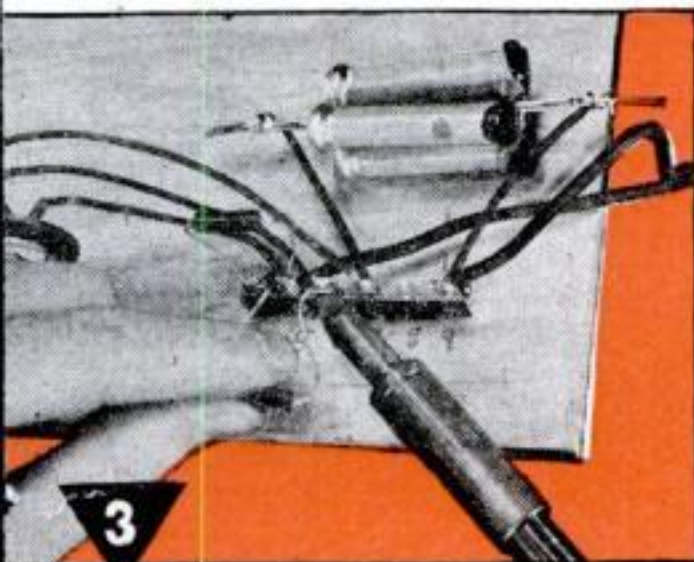
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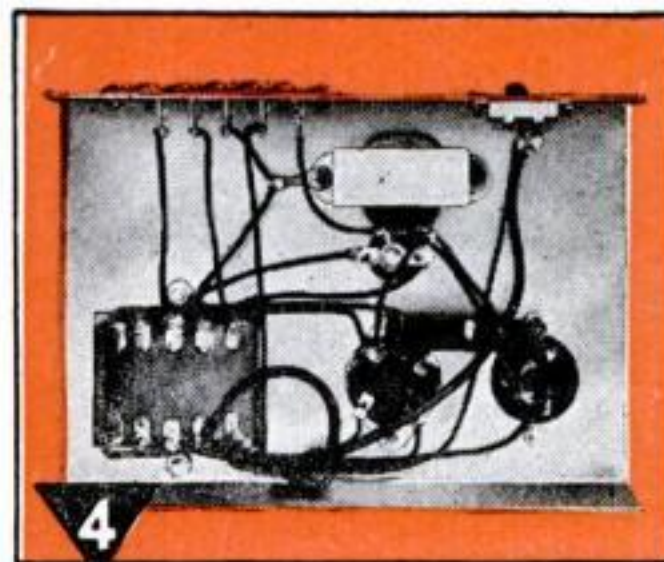
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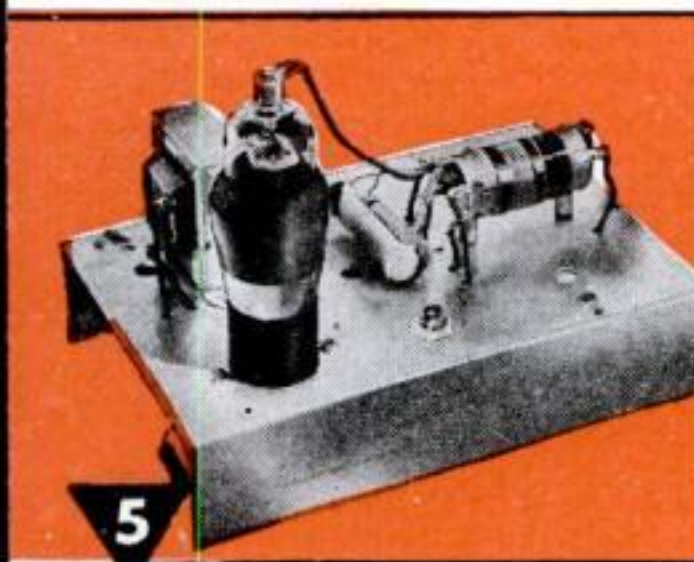
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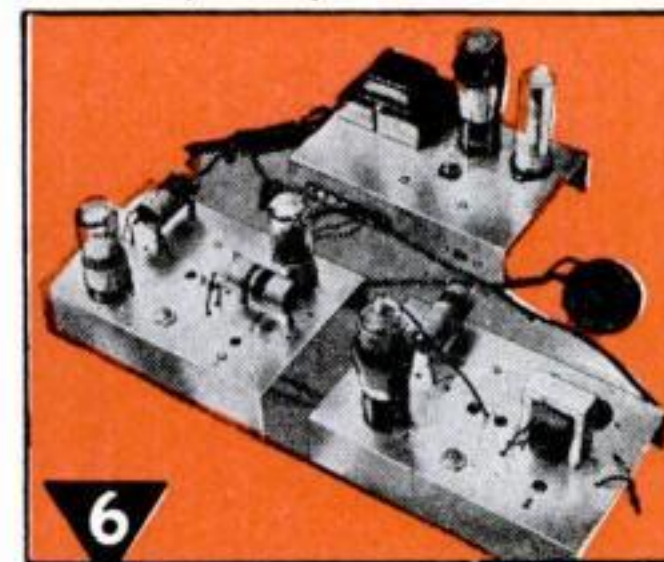
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